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Our Medal of Honor

THE International Jury of Awards, Panama-Pacific International Exposition, has voted to give a medal of honor to the publications of the McGraw Publishing Company, Inc., which include the ELECTRICAL WORLD. This is the highest award granted a publishing company. The principal basis of the award is the general excellence and superiority of the publications.

Rate-Research Activity

THOSE who are deeply interested in the rate-making problems of central stations regretted to hear the recommendation of the rate-research committee of the National Electric Light Association, presented in the report last week, that its activities be lessened. It is even more regrettable that after its great labors in past years the committee should have felt such a recommendation to be desirable. Rate-making will never be ended. Even if broad principles should become so standardized as to receive unanimous approval from all conflicting interests, there still would be many large issues on which settlement would be possible only after laborious negotiation. Until there shall be substantial agreement by companies, the general public and consumers on all of the intricate points involved, there will be serious work and responsibility for a rate-research committee.

City Partnership in a Strike

ONE of the theories held in regard to the "city partnership" form of franchise is that it will lead city authorities to take some responsibilities of partnership. This theory has been undergoing test in the strike of trainmen on the Chicago surface and elevated electric railways. Even though the strikers were guaranteed against loss of any of their advantages in wages and hours, they refused to accept the principle of arbitration. The Mayor, therefore, declared that he would perform to the best of his ability the duty of safeguarding the rights, lives and property of the citizens and those doing business legally in the city. Outside of the keen public concern in paralysis of urban transportation facilities, the city has a direct interest through the franchise provision giving it 55 per cent of the net receipts remaining after certain agreed deductions. The city authorities cannot disregard the fact that interruption of service by strike means interruption of profit. The "partnership" plan is weak in theory because, if loss develops, the city loss is limited strictly to decrease or stoppage of profit; the city is not liable for obligations. If, however, the city gives in practice the moral support which a partner of limited liability would give in a grave emergency, the plan will undoubtedly commend itself for further extension. It is gratifying to find that the firm insistence of Mayor Thompson during two days of negotiation led the strikers to accept the arbitration which they had rejected previously.

Organization of the Manufacturers

RECENT developments promise a higher degree of co-operation between different branches of the electrical industry which will promote their joint prosperity. The agency for making the co-operation of manufacturers effective is the clearing house first suggested by Mr. Thomas M. Debevoise, counsel for the Associated Manufacturers of Electrical Supplies, and indorsed by Mr. R. K. Sheppard, president of that organization, and by Dr. Francis B. Crocker, formerly president of the Electric Power Club, in letters published in the ELECTRICAL WORLD for May 1, 1915, and June 5, 1915, respectively. With the appointment last week of a committee of the new Associated Manufacturers of Electrical Supplies to meet with similar committees of the Electric Power Club and the Electrical Manufacturers' Club, created previously, the larger clearing house is near realization. Supplementing this and expressing the same desire for more efficient organization, the National Electric Light Association, upon the recommendation of Retiring-President Scott, has provided for a Manufacturers' Section. Thus is illustrated anew the clear tendency toward more united organization. Embryonic though the plans are, they hold very encouraging possibilities for constructive influence in keeping with the larger opportunities of brighter future years. Undoubtedly careful study will prevent duplication of effort and assure at all times economy and productive unity of action.

Continued Gains by Central Stations

OUR compilation of central-station returns for March, 1915, covering companies with $18,600,000 gross income in that month and representing 64 per cent of the business of the industry, shows a gain, as compared with March, 1914, of 6.4 per cent in gross income and 4.8 per cent in output of electrical energy. In both items this is the best record of gains since last September. Reference to the statistics published elsewhere in this issue indicates that there was improvement in all four divisions of the country into which the returns are separated. All reported better results than

in the preceding month of February. The fact that income increased by a larger percentage than did the kilowatt-hour output indicates that the consumption of energy for domestic service at the higher rates is nearer normal. When the ELECTRICAL WORLD began its compilations the increase—covering May, 1914, as compared with May, 1913—was 9.1 per cent in gross income and 12 per cent in the output of energy. The record of the companies during the ensuing months of historical importance and business unrest is as exceptional as is the record of the industry from its young days. To maintain gains over the previous year, even though they are small in percentage, is a substantial achievement of which the industry may well be proud. Since expansion has been curtailed, the gains mean intensive development of territory and customers, and they therefore represent commercial results of the first order.

Electric Furnaces and the Central Stations

Three important papers dealing with various phases of the electric-furnace loads were read before the convention of the National Electric Light Association. As regards the character of their work electric furnaces fall roughly into three classes—heating furnaces for baking, annealing and similar work; smelting and melting furnaces, and those for purely electrochemical work of a varied character, including the preparation of various compounds and the fixation of atmospheric nitrogen. The first class is increasing rapidly in number and in the scope of its operations. As the individual furnaces are generally not very large, they can conveniently be supplied with energy without particular difficulty by central stations. As a rule they do not work continuously throughout the twenty-four hours; but for the factory day in which they are used they show a good load-factor, said to be as high as 60 per cent. The advantages of such furnaces over the gas-fired and oil-fired types still largely used are very considerable, particularly in the exact control of the temperature, the lessened formation of scale on the articles heated, simplification of the general plant, and much less waste heat. From the central-station point of view the furnace business is good, the only objection being that it is difficult to keep off the peak.

Of the larger electric furnaces a fair type is that used in the making of steel. Experience seems to have shown that a particularly fine grade of steel castings can be obtained by the use of the electric furnace, and its employment is increasing. The average load of such furnaces and those used for smelting work is very much greater than in the case of furnaces of the first class, running to several hundred or even thousand kilowatts. In some of the larger furnaces it is possible so to adjust the work as to enable the consumer to utilize off-the-peak energy. One of the practical difficulties in supplying energy to the larger furnaces is that the majority of them require single-phase, which involves some complications in the supply system. Work of this sort is best done by setting aside certain transmission lines and generators directly for the furnace load when it is large.

As to the class of electric furnaces devoted to electrochemical reactions, requirements are very various, but the output demanded is commonly large. In many instances the operation is not continuous even when the plant runs for twenty-four hours per day, but a succession of charges is worked off, which gives again a chance for keeping the heaviest furnace loads off the peak. Certain kinds of electrochemical work can very easily be adjusted to this mode of operation, and one should therefore be able to buy energy for the purpose at considerably less than the usual rates. Taken altogether, the possibilities of electric-furnace work for central stations and transmission companies are very large and should be looked into most thoroughly. Perhaps the greatest opportunity for the development of the industrial field lies in certain of the specialized electrochemical processes. These might sometimes be taken up with advantage by the energy-supply companies themselves, so as to utilize not only off-the-peak energy but the energy available during a large part of the year which could be made useful by any industry where the output could conveniently be varied from season to season. We have hardly begun in this country to utilize the electric furnace fully, and the next few years are likely to see a great increase in service of this character.

The Standby Plant Problem

In the experience of the Pacific Gas & Electric Company large advantages have been obtained by utilizing oil fuel for emergency standby service. There are three standby plants, of which the chief one, in San Francisco, operates regularly in parallel with the transmission system, although a certain number of boilers are kept under steam to pick up load in an emergency. In this plant the normal method of operation, as described in the N. E. L. A. convention paper by Mr. C. H. Delany, is to keep the boilers operating at light load, ready to be forced when necessary. The Oakland station, of about half the rating of that in San Francisco, is worked with a single turbine unit floating on the line but ready to carry at any time more than 6000 kw. In this station the advantages of oil firing are conspicuous. Of the twelve boilers all are ready for prompt use, the oil burners being kept going under three of them for three hours and then shifted to three other boilers for a similar period. Three boilers are, therefore, always working, and three boilers are very hot and ready for instant forcing. It is in such work as this that oil fuel, with its extreme rapidity of action, scores heavily. No fire is to be banked when the heat is shifted from one set of boilers to another, and the oil burners of every boiler not actually under steam can be put in service in less than one minute. With three boilers working and three more hot, anything except a very heavy load can be taken care of almost on the instant. As the plant is ordinarily worked nine boilers are actually kept hot. This involves considerable ex-

pense for oil, although the largest outlay comes in keeping one turbine in action. The large amount of steam used by the auxiliaries in floating a turbine on the system makes the operation a very wasteful one, not to be recommended unless there is actual need for instantaneous standby service.

Where it can be obtained at reasonable expense the use of fuel oil seems to be especially attractive in standby plants of every description on account of the great rapidity with which the fire can be started and the complete absence of anything like banking with coal. When steam is not needed from an oil-fired boiler the fire is put out and the damper shut. Then, by a few minutes' oil-firing every hour or two, steam can be maintained at nearly full boiler pressure. The disadvantages seem to be that steam enough for atomizing the oil in all the burners must be provided for sudden use, and contrary to ordinary opinion it is found that the boiler tubes require considerable care on account of soot.

Most so-called standby plants belong to the type in which no machinery is actually kept running, but provision must be made for the quickest possible taking up of the load when required. In such a case it is quite certain that oil has the advantage, since steam pressure can be maintained by intermittent burning and the plant will be ready for full operation about as quickly as the hot boiler can be given its oil. Perhaps the whole case may be summed up by saying that the quicker the plant must get into action and the oftener it is likely to be required, the greater the advantage of oil burning, provided that the conditions of cost permit. With induced draft one can go to full steam pressure from a banked fire with astonishing rapidity—in five minutes or less. But it is expensive to run continuously with banked fires at the point where this speed is possible. It will be interesting to examine the possible results of combined oil and coal firing, with oil used merely to keep up heat until the induced draft can do the rest. Banking fires ready for quick starting is an expedient sufficiently costly to make the development of economies particularly desirable.

Skin Effect in Bimetallic Wires

When a straight cylindrical copper wire carries a steady continuous current the current distributes itself uniformly over the cross-section of the wire; or, in other words, the current density is uniform at all points in the cross-section. The heating of the conductor by the current is, therefore, a minimum for that current and size of wire. If the current density were unequally distributed over the cross-section, there would be extra heating at the places where the density was above the average and less heating at the places where the density was below the average, and the total heating would surely be increased. When a current first commences to flow in a wire it begins at the surface, and the metallic conduction works inward at great speed. On account of electromagnetic repulsion each and all parts of the wire, if uniform, finally receive their fair share of current. Strictly speaking, of course, the absolute justice of this partition is never completely enforced in finite time; but the quality of justice is so strained that ordinarily, after a small fraction of one second from starting the current in a simple circuit, the residual deviation from strict uniformity in current density over the cross-section cannot be detected with existing apparatus.

If, however, a simple alternating current is started in the wire, the alternations commencing at the surface may not have time to "soak in" before they are pulled out again and reversed; so that only for small wires, which do not have far to soak, or for low frequencies, do the current densities become uniform. They clearly tend to develop more quickly near the surface than near the axis. This means extra heating, extra apparent resistance in the wire to alternating currents, and what is commonly called the skin effect. The amount of this extra resistance to alternating-current flow can be computed by the mathematics of the soaking-in theory. But this is not the only way of treating the subject. It is evident that, starting from the axis, the internal portions of the wire have more linear self-inductance than the external portions. Hence the inner portions may be considered as working in parallel with the outer portions, but being loaded by containing an extra inductance. This will clearly diminish the current carried by the inner portions, and also retard its phase. The same results, as to the magnitude of skin effect, may, therefore, also be reached by means of the mathematics of the steady alternating-current divided circuit.

Whichever way the problem is attacked, whether by considering soaking, in the unsteady state, or subdivision and loading, in the steady state, one arrives at certain numerical results, first worked out fully by Heaviside and Kelvin. These results are definite for the case of straight cylindrical copper wires remote from disturbing alternating fields. However, when considering steel wires, one is confronted with an additional difficulty in the fact that the permeability of steel varies with the magnetic force, and the latter varies in turn with the distance from the axis of the wire. Hence the skin effect is not the same throughout the substance of a steel wire. Nevertheless, by assigning an average effective value to the permeability in the steel, one can arrive at a fairly satisfactory result.

In the case of bimetallic wire, with a steel core and a welded cylindrical envelope of copper, the complexity is increased one stage further. In an article in this issue by Mr. John M. Miller the bimetallic wire problem is discussed on the subdivided circuit basis, the steel wire with its average reactance being considered as one conductor, and the external copper shell with its lower reactance as the other, the two being placed in parallel. Using the best available average value of permeability, the agreement reached between the observed and calculated skin-effect ratios, at different frequencies up to 3000 cycles per second, is as good as can well be expected, and amply sufficient for ordinary engineering purposes.

LETTER TO THE EDITOR

Incandescent Versus Arc Lamps

To the Editor of the ELECTRICAL WORLD:

SIR:—The editorial on this subject in your issue of April 10, while interesting and suggestive, is pretty certain, I think, to give a somewhat erroneous impression as to the present status and future possibilities of the arc lamp for street lighting. You say: "That the gas-filled lamp would make serious inroads upon the use of the arc lamp for street lighting was a foregone conclusion from the very first appearance of this latest development of incandescent lighting."

The standard for street lighting is to-day set by the magnetite-arc lamp. To be sure, there are still some installations of the early types of open and inclosed arc lamps, and while these installations are historically of interest, they serve merely as invitations to change and as a reminder of the tremendous advance in the art which the magnetite lamp evidences. The companies operating them will, of course, replace them as soon as available funds make it possible to do so. When one considers the magnetite-arc lamp, however, it hardly seems a foregone conclusion that the gas-filled lamp will make serious inroads upon its use in street-lighting.

"Hundreds of central-station managers are worried over the matter and are rather in a quandary as to the steps to be taken when their present contracts are to be renewed."

There are certainly many central-station managers operating magnetite-arc lamps in the East and Middle West who, to my knowledge, are undisturbed by the advent of the gas-filled lamp, are distinctly satisfied with present operating results, have confidence in the consistent future development of the magnetite-arc lamp, and who will undoubtedly and unquestionably renew present contracts with this unit as a standard. To quote from an editorial in the ELECTRICAL WORLD of Oct. 3, 1914, page 647, on "Advance of the Arc Lamp":

"The combined gains in luminous efficiency secured by recent developments in electrodes and by the application of the prismatic refractor are so great that even the gas-filled incandescent lamp has been distanced for the time being. When the losses in the lamp transformer are taken into account it is doubtful if the moderate sizes of gas-filled lamp can show much lower consumption than from 0.8 watt to 0.9 watt per mean spherical cp, while the new 5-amp luminous arc lamp equipped with the high-efficiency electrode consumes only 0.61 watt per mean spherical cp, . . . but further improvements are pretty certain to come in time, and the central-station manager or municipal official who thinks that the knell of the arc lamp was sounded by the advent of the gas-filled unit should lose no time in revising his views."

Also see article by Mr. Preston S. Millar in ELECTRICAL WORLD of Jan. 2, 1915, from which I quote:

"New electrodes have been produced by means of which the efficiency is increased something like 50 per cent over that of the standard type of electrode heretofore used. Moreover, the construction of the lamp has been modified somewhat, and a refractor has been made available by means of which a larger proportion of the light from the arc may be utilized. At the same time, the available systems at 4 amp and 6.6 amp have been supplemented by a new system for operation at 5 amp. It is reasonable to say that the improvement in the magnetite-arc lamp during the past year parallels in time and extent the improvement in tungsten lamps due to the use of an inert gas in the bulb."

In your editorial you say: "The simplicity of the incandescent lamp, its high efficiency and its steadiness are very strong points in its favor, besides which it appeals to the imagination of the man on the streets as a new thing worthy of encouragement, and if anything further were needed to worry the advocates of the arc lamp, it may be found in the present war, with its practical suppression of traffic in the electrodes quite generally imported for use in flaming-arc lamps."

So far as simplicity is concerned, there is certainly little, if any, advantage in the gas-filled lamp, with its glassware and housing as used for street lighting, over the magnetite-arc lamp of to-day.

As to efficiency, the half-watt gas-filled lamp has been on the tongue so constantly of late that one is apt to overlook the fact that, although with a 600-cp series gas-filled lamp operated on a 20-amp line the lamp bare consumes 0.5 watt per mean horizontal cp, with a spherical reduction factor of 0.78 this same lamp requires 0.64 watt per mean spherical cp. A lamp to be operated on a 6.6-amp line, with a compensator for 20 amp in the lamp, will operate bare at 0.53 watt per mean horizontal cp, or 0.68 watt per mean spherical cp.

As is so well said in the editorial: "Where the more powerful magnetite units of the ordinary or the boulevard type are in use, the substitution of incandescent lamps becomes a more difficult matter despite the advantage gained by the incandescent lamp in not requiring direct current for its operation. This advantage, indeed, is somewhat nullified by the requirement of operation of the incandescent lamps at high current by means of auto-transformers if their highest efficiency is to be attained. And while by this means the use of rectifiers is obviated, the auto-transformer certainly does not improve the power-factor, nor does it avoid the use of constant-current transformers with their heavy inductive effect and somewhat modest efficiency, save at full load."

A bare gas-filled lamp operating on a 6.6-amp line will consume 0.64 watt per mean horizontal cp, and with a spherical reduction factor of 0.8 will operate at a specific consumption of 0.80 watt per mean spherical cp. When this lamp is equipped with a reflector or diffusing globe, such as is suitable for street-lighting service, the consumption rises to from 1.00 watt to 1.25 watts per mean spherical cp.

The efficiencies are, of course, materially lower than are obtained from the magnetite-arc lamp operating on the usual commercial 6.6-amp circuits. In this connection the following quotation from the ELECTRICAL WORLD of Jan. 2, 1915, page 22, being an article by Mr. Preston S. Millar on "Developments in Illumination During 1914," is pertinent:

"The average gas-filled lamp as manufactured at the close of 1914 probably operates at a specific consumption approximating 0.9 watt per mean spherical cp, or at an output of 14 lumens per watt, this figure, of course, applying to a new bare lamp. This represents an increase in efficiency of about 40 per cent over the vacuum type of tungsten lamp of the same size available at the end of 1913."

The man on the street, whose craving for new developments is proverbial, will find the progress in the field of the magnetite-arc lamp sufficiently marked to occupy his attention at present and to stimulate his interest for some time to come.

The influence of the present war on the supply of electrodes is hardly an important factor and apparently

gives rise to no serious concern among users of flame-arc lamps, as is shown by the advertisement on the inside of the back cover of the ELECTRICAL WORLD of April 10, 1915, announcing the immediate installation of an initial equipment of 3000 flame lamps. As a matter of fact, the city of Chicago is using white-flame arc electrodes purchased in this country from the National Carbon Company at a cost less than that of imported electrodes, and these domestic electrodes are giving entire satisfaction.

As for magnetite electrodes, it is possible to manufacture them from ingredients obtained wholly in the United States, and the imported material sometimes used in their production exists to the extent of a ten years' supply with one of the large manufacturing companies. The situation, therefore, would hardly seem to justify any uneasiness on this score.

"Out of the total of 505,395 arc lamps reported by commercial and municipal central electric stations, 348,643, or 69 per cent, were for street lighting."

The quotation just given from the ELECTRICAL WORLD of Feb. 6, 1915, page 344, which refers to statistics of the 1912 census reports, is significant when it is recalled that of the 348,643 lamps there referred to something over 200,000 are magnetite-arc lamps.

"The first activity should be to put out of business all the old and inefficient types of carbon-arc lamp, open and inclosed, especially those of the alternating-current type. There is no excuse whatever for continuing, for example, the use of the 6.6-amp alternating-current lamp, save the one of unwillingness to incur the expense of a change to incandescent lamps. Even the 7.5-amp alternating-current arc lamp is sure to follow its smaller mate into oblivion, with direct-current arc lamps, open and inclosed, not far in the rear."

In the above opinion, one can heartily concur if the magnetite-arc lamps and the direct-current inclosed flame-arc lamps be excluded. It can hardly be the intention of the editorial to include these types among those soon going into oblivion.

"The flaming-arc and luminous-arc lamps present another problem. They are quite as efficient in the matter of light-giving power as are the gas-filled incandescent units, are of conveniently large power, and possess a material advantage in their much more striking effect upon the street, due to the white color given by the electrodes now commonly in use. These lamps give to street illumination a distinctive character, which it seems somewhat to lack when the change to incandescent lamps is made. The white arc lamps belong to the street itself, while the yellowish incandescent units seem to melt into the general illumination along the way without possessing any individuality of their own."

This quotation is one of great importance, and much might be said as to the advantages of the white light of the magnetite-arc lamp over the yellow light of the gas-filled lamp. The satisfaction from a number of points of view arising from the whiteness of the light from the magnetite when seen in contrast with the yellow light from the shops is one striking feature to be given careful consideration with street lighting using magnetite-arc lamps.

For ornamental out-of-door illumination on a large scale, the magnetite-arc lamp possesses a marked and well-recognized superiority over the gas-filled lamp, as the following quotation from the ELECTRICAL WORLD of Feb. 13, 1915, pages 391-2, shows. The article is by G. L. Bayley, chief of mechanical and electrical department, on "Illumination of Panama-Pacific Exposition":

"The general scheme adopted was to feature the beauty of the buildings, courts, paintings and decorations and make the lighting subservient to this end. Flood lighting from screened searchlamps has been used on a large scale, and other light sources have been hidden as far as possible, except in formal gardens, where the treatment admits of the use of incandescent standards. . . . Magnetite-arc lamps have been used for both types, and the construction is such that the lamps are so inclosed by the decorations as to be hidden from general view. . . .

"Uniform wall illumination prevails, and the colors and decorations which mark the entrances to the buildings and courts are given their true tone and definition by this form of lighting. The light which filters through the translucent fabric openings in the staff standards and the canvas banners adds a pleasing bit of color to the night picture quite in harmony with the general color scheme. . . .

"A moderate amount of light is reflected from the building wall surface to the adjacent roadways, but not sufficient for traffic requirements. To augment this reflected light incandescent standards have been installed along the curbs of the roadways."

To quote from the editorial in question:

"The change from one illuminant to another, which has gradually progressed, is much less marked in cities provided with flaming-arc or magnetite-arc lamps than elsewhere. In some instances—for example, in Hartford—the 4-amp magnetite lamp has been replaced by the gas-filled incandescent lamp, but with a tendency toward maintaining a somewhat closer spacing than with the old arc lamps so far as such a change is practicable."

The one instance in which the magnetite-arc lamp has been replaced by the gas-filled incandescent lamp is the city of Hartford, Conn., and as one swallow does not make a summer, certainly before the bird has matured, so one change from magnetite-arc to gas-filled incandescent lamps does not set a standard in street illumination.

Again, quoting from the editorial:

"All the older arc lamps can be, of course, replaced, lamp for lamp, by high-power incandescent units, with an increase in illumination and the advantage of great steadiness; but such a substitution may not be wise in view of the very poor lighting midway between lamps found in American practice. For instance, it is not uncommon to find arc lamps, and poor ones at that, spaced 300 ft. apart in a city progressive enough and wealthy enough to enjoy good lighting."

In Boston, Springfield, Providence, Lynn, Beverly and various other cities, where magnetite-arc lamps are spaced 300, 500, 600, and in certain instances even 800 ft. apart, the illumination is effective and satisfactory for the purpose for which it is designed.

"The path of progress lies not in replacing a poor arc lamp by a somewhat better incandescent unit, but in making radical improvement in the lighting of the street by changing the spacing as well as the illuminant."

With the range in wattage of lighting units available in the magnetite-arc lamp, remembering that 4 amp, 5 amp and 6.6 amp are now standard; with the high-efficiency electrode, with the marked increase in life of electrode now possible with improved lamp design, with the ornamental luminous type, the refractor type, and the certainty of still further important developments in the magnetite-arc lamp, one can hardly be otherwise than enthusiastic as to its continually increasing use in street lighting, with resulting gain to the public in improved illumination and to the central-station manager in increased demand for his output.

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Boston, Mass.

Electrical Supply Jobbers Meet at Detroit

The problems of economical lamp distribution and the need for higher grade and more intelligent salesmanship were the chief topics of interest discussed at the meeting of the Electrical Supply Jobbers' Association at Detroit on June 15 to 17.

Two papers on the "Weak Points of the Jobber" were presented by Mr. Warren Ripple of Chicago and Mr. J. H. Trumbull of Plainville, Conn. Mr. Ripple declared in his paper that a higher order of salesmanship more intelligently directed is needed in jobbers' organizations. With proper efforts made in this direction no jobber will need to fear any competition. Commenting further on the inefficiency of jobbers' salesmen, Mr. Ripple said that these traveling representatives are not capable of creating or discovering new business because they lack fundamental knowledge regarding the variety of uses of the goods they are selling. In the discussion of this paper Mr. E. W. Rockefeller of New York City stated that he had adopted an exhibit system whereby all salesmen are given an opportunity to see the actual goods they are selling instead of merely the pictures of the products.

In his paper Mr. Trumbull suggested that jobbers should endeavor to represent manufacturers producing goods of standard quality instead of those handling low-price products of inferior quality. At the request of the Chamber of Commerce of the United States, an effort is to be made by the association to determine the consensus of opinion regarding the advisability of maintaining resale prices of merchandise.

Acting on a suggestion by Mr. J. H. Trumbull the jobbers' association decided to appoint a delegate to meet with the electrical manufacturers' committee which is considering the advisability of introducing concentric wiring in the United States. The next meeting of the association will be held in September at the Clifton Hotel, Niagara Falls, Canada.

Meeting of Governors of Associated Manufacturers

A meeting of the board of governors of the Associated Manufacturers of Electrical Supplies was held at the Hotel Biltmore, New York, on the evening of June 10. It was decided to open headquarters for the association at 62 Cedar Street, New York, where correspondence will be handled and the official headquarters of officers will be located. Mr. Charles E. Dustin was elected general secretary and will be at the New York office, which is to be opened immediately. In recent years Mr. Dustin has been in the stock and bond brokerage business in Hartford, Conn. Formerly he was president of the Schuyler Electric Company.

An executive committee was formed, to consist of the president, vice-president and treasurer. This will be a standing committee with power to act in the interim between meetings of the board of governors. The following committees were appointed:

Membership committee—Messrs. W. C. Robinson, president of the National Metal Molding Company, Pittsburgh, chairman; Walter D. Steele, Benjamin Electric Manufacturing Company, Chicago; Oscar Hoppe, H. T. Paiste, B. E. Salisbury, Pass & Seymour, Inc., and J. H. Trumbull, Trumbull Electric Manufacturing Company.

Finance committee—Messrs. J. F. Kerlin, National Carbon Company, Cleveland, chairman; Charles L. Eidlitz, New York; W. C. Bryant, Bryant Electric Company; R. E. Gallaher, New York Insulated Wire Company.

Legal committee—Messrs. D. C. Durland, Sprague Electric Works of the General Electric Company, New York, chairman, and D. H. Murphy.

Publicity committee—Messrs. A. W. Berresford, Cutler-Hammer Manufacturing Company, Milwaukee, Wis.; John C. Bridgman, G. M. Hazzard, Harvey Hubbell, Harvey Hubbell, Inc., and L. J. Campbell, Western Conduit Company.

By direction of the board, the president, Mr. R. K. Sheppard, appointed a conference committee to meet with similar committees of the Electrical Manufacturers' Club and the Electric Power Club and discuss matters of interest to the various bodies. The members of this committee are Messrs. H. B. Crouse, Crouse-Hinds Company, Syracuse, N. Y., chairman; John F. Kerlin, B. E. Salisbury, L. J. Campbell, and H. Durant Cheever, president of the Okonite Company. The committee of the Electrical Manufacturers' Club is composed of: Messrs. George A. Cragin, American Steel & Wire Company, chairman; D. R. Bullen, General Electric Company; Charles Robbins, Westinghouse Electric & Manufacturing Company; A. W. Berresford, Cutler-Hammer Manufacturing Company, and E. B. Hatch, Johns-Pratt Company, Hartford, Conn. The Electric Power Club committee is as follows: Messrs. S. L. Nicholson, general sales manager Westinghouse Electric & Manufacturing Company, chairman; C. L. Collens, president Reliance Electric & Engineering Company, Cleveland; J. C. Hobart, president Triumph Electric Company, Oakley, Cincinnati, Ohio; Walter Robbins, vice-president Wagner Electric Manufacturing Company, St. Louis, Mo.; H. C. Petty, Crocker-Wheeler Company, Ampere, N. J.

Wire and Cable Section

The rules and by-laws of the wire and cable section were approved, and with the indorsement of the board President Sheppard appointed as chairman of that section Mr. W. A. Connor, vice-president of the Standard Underground Cable Company.

The rules of the wire and cable section provide that each member enrolled in the section shall be represented by one or more excutive or associate representatives and shall be entitled to one vote at all meetings of the section. Regular meetings of the section shall be held on the third Thursday of each month at such hour and place as the chairman of the section may fix. Special meetings may be called by the chairman and shall be called by him on the request in writing of a majority of the executive committee or of not less than 25 per cent of the members of the section.

Twenty-five per cent of the members of the section shall be a quorum at all of the meetings. A less number may adjourn. The fiscal year of the section shall begin on March 1 and end on the last day of the following February. The chairman of the section shall be chosen each year in the manner provided by the by-laws of the association for the choice of the chairman upon the formation of the section. At the first meeting in each year after the annual meeting of the association the members of the section shall elect by ballot a treasurer and a secretary. The chairman shall preside at the meetings of the section and be its executive head in all of its activities.

The management of the section shall rest in an executive committee of five members, which shall be elected at the organization meeting of the section and thereafter annually at the first meeting of the section held after the annual meeting of the association in each year. Whenever a vacancy shall occur in the executive committee the members of the committee then remaining in office may, by the affirmative vote of a majority of all of them, elect a successor. Members of the executive committee may be either executive or associate representatives of members. The section shall have

such standing committees and such other committees as the members or the executive committee may consider necessary, all of which shall be appointed by the chairman. By a four-fifths vote of the entire executive committee any member or representative may be expelled from the section for any cause, provided that such member shall have an opportunity to be heard before the committee. On the question of expulsion no accusing or accused member or representative shall be entitled to vote. The rules may be supplemented, amended or repealed by a majority of the members present at any meeting of the section subject to the approval of the board of governors.

Both the conduit and the wire and cable sections have now been organized, and during the summer months the board of governors proposes to continue the general work of organization, and particularly to prepare for an active campaign to develop the sectional work this fall.

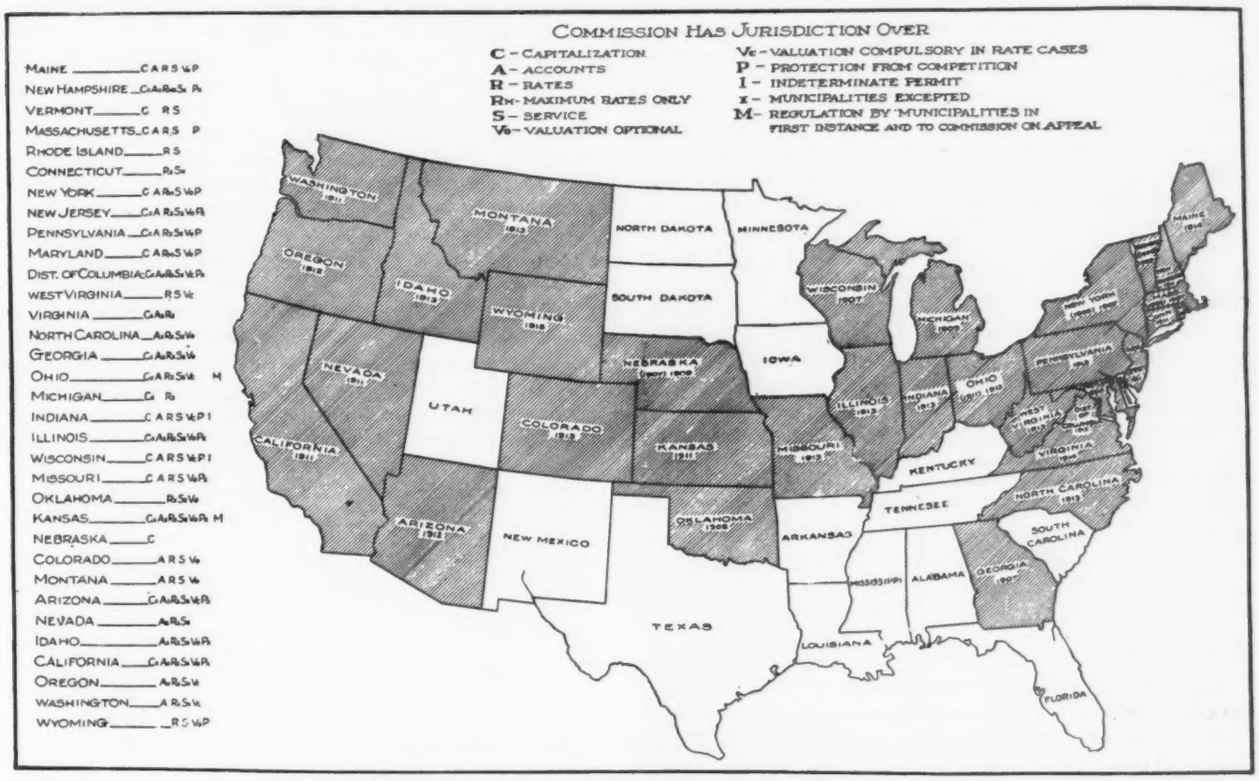
Changes in Board of Governors

Some changes have been made in the board of governors. Two new members are Messrs. B. E. Salisbury and J. J. Gibson, Westinghouse Electric & Manufacturing Company. Besides these two the board is composed of Messrs. D. C. Durland, H. B. Crouse, LeRoy Clark, Safety Insulated Wire & Cable Company, New York; Charles Blizard, Electric Storage Battery Company; J. W. Perry, H. W. Johns-Manville Company; R. K. Sheppard, B. F. Goodrich Company, Akron, Ohio; E. R. Holmes, R. Thomas & Sons Company, East Liverpool, Ohio; W. C. Robinson, National Metal Molding Company, Pittsburgh; Walter Robbins, Wagner Electric Manufacturing Company, St. Louis, Mo.; A. W. Berresford and J. F. Kerlin. There are two vacancies which it is expected will be filled later.

The president of the association is Mr. R. K. Sheppard, the vice-president is Mr. H. B. Crouse, and the treasurer is Mr. J. W. Perry.

State Regulation of Electrical Utilities

In the report of the public policy committee presented at the National Electric Light Association in San Francisco last week a chart was published to show the extent of the regulation of electrical utilities by state public service commissions. The committee called attention to the fact that the practice of regulation which the association has supported from the outset has been continued without exception where it was in effect previously, and since Jan. 1, 1914, has been adopted also by Maine, Virginia and Wyoming. The chart shows states that now have such regulation, those that are without it, and gives information as to the time of adoption and the varying degrees of regulation prescribed by the laws. Thirty-two states and the District of Columbia now have commissions regulating electric-lighting utilities. There are still fifteen states without such regulation.


COMMISSION HAS JURISDICTION OVER
C - CAPITALIZATION
A - ACCOUNTS
R - RATES
Rm - MAXIMUM RATES ONLY
S - SERVICE
Vo - VALUATION OPTIONAL
Ve - VALUATION COMPULSORY IN RATE CASES
P - PROTECTION FROM COMPETITION
I - INDETERMINATE PERMIT
x - MUNICIPALITIES EXCEPTED
M - REGULATION BY MUNICIPALITIES IN FIRST INSTANCE AND TO COMMISSION ON APPEAL
MAINE ____ C A R S Ve P
NEW HAMPSHIRE ____ C A R S Ve P
VERMONT ____ C R S
MASSACHUSETTS ____ C A R S P
RHODE ISLAND ____ R S
CONNECTICUT ____ R S
NEW YORK ____ C A R S Ve P
NEW JERSEY ____ C A R S Ve P
PENNSYLVANIA ____ C A R S Ve P
MARYLAND ____ C A R S Ve P
DIST. OF COLUMBIA ____ C A R S Ve P
WEST VIRGINIA ____ R S Ve
VIRGINIA ____ C A R
NORTH CAROLINA ____ A R S Ve
GEORGIA ____ C A R S Ve
OHIO ____ C A R S Ve M
MICHIGAN ____ C R
INDIANA ____ C A R S Ve P I
ILLINOIS ____ C A R S Ve P
WISCONSIN ____ C A R S Ve P I
MISSOURI ____ C A R S Ve P
OKLAHOMA ____ R S Ve
KANSAS ____ C A R S Ve P M
NEBRASKA ____ C
COLORADO ____ A R S Ve
MONTANA ____ A R S Ve
ARIZONA ____ C A R S Ve P
NEVADA ____ A R S
IDAHO ____ A R S Ve P
CALIFORNIA ____ C A R S Ve P
OREGON ____ A R S Ve
WASHINGTON ____ A R S Ve
WYOMING ____ R S Ve P
WASHINGTON 1911
OREGON 1913
CALIFORNIA 1911
NEVADA 1911
IDAHO 1913
MONTANA 1913
WYOMING 1913
UTAH
ARIZONA 1912
NEW MEXICO
COLORADO 1913
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA (1907) 1909
KANSAS 1911
OKLAHOMA 1914
TEXAS
MINNESOTA
IOWA
MISSOURI 1913
ARKANSAS
LOUISIANA
WISCONSIN 1907
ILLINOIS 1913
MICHIGAN 1909
INDIANA 1913
OHIO (1911) 1913
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA 1907
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA 1913
VIRGINIA 1914
WEST VIRGINIA 1913
PENNSYLVANIA 1913
NEW YORK (1910) 1910
MAINE 1914

STATE COMMISSIONS WITH JURISDICTION OVER ELECTRICAL UTILITIES

Princeton Confers D. Sc. Degree on Edison

Princeton University conferred the degree of Doctor of Science upon Mr. Thomas A. Edison at the school's 168th commencement June 14. At the same time the degree of Doctor of Laws was conferred upon Mr. Theodore N. Vail, president of the American Telephone & Telegraph Company, and upon Col. George W. Goethals, builder of the Panama Canal.

In admitting Mr. Edison to the degree of Doctor of Science Dean West said: "Thomas Alva Edison, prolific and ceaseless inventor, notably of the carbon telephone transmitter, the phonograph, the incandescent electric lamp, the three-wire system, the motion-picture camera, the alkaline storage battery, and several modes of generating, regulating, measuring and distributing the electric energy for light, heat and power. Endowed with keen insight akin to foresight, he was able to see what physical devices would be most serviceable for

human advantage and comfort. Watching every suggestion, even the lightest, exploring every nook and trying every chance, he persisted with endless patience in the face of continuing discouragement, steadily improving his initial inventions till they were perfected for universal use. For this enormous benefit the whole world is his debtor. I admit you to the degree of Doctor of Science."

ELECTRICAL MARKETS IN BRAZIL

Opportunities in Pernambuco if the Government Permits Combination for Foreign Trade

BY H. N. DOUTHITT*

From the standpoint of applied electrical energy, Pernambuco, the capital of the Brazilian State of that name, has been practically overlooked, although it presents almost untold possibilities for progressive electrical central-station companies that have the capital and ability to carry out their ideas. Had some energetic company started to provide central-station service for this city when Rio de Janeiro and Sao Paulo first took up the problem, Pernambuco would be a close second to Sao Paulo, one of the most progressive and best commercial cities in Brazil.

Receif, or Pernambuco, as the outside world knows it, is the capital of a most progressive State. It has a population of 186,000, with paved streets, attractive residence and business section, 130 factories and all the accessories that go to make an up-to-date city. The district that was formerly known as "the old town," along the water front, is being entirely rebuilt. A modern dock is under construction, and many business houses are being built and the streets widened. The factories represent a capital of $20,000,000, with an annual production of over $19,000,000. The State and city governments are among the best managed in Brazil. Each has the confidence of the people and a surplus in the treasury. But for some reason the city has been overlooked by capitalists and electrical interests of North America.

Would American capital have neglected a city of 175,000 inhabitants in Canada or even in Mexico, where the dangers attendant upon investment are far greater than in Brazil? Would American financiers have failed to find a city of this size, where the establishment of an electric railway would receive the patronage of one-half of the population every day if such a city were in North America? This is the chance which they have overlooked in not locating in Pernambuco, the last of the large South American cities to possess an electric railway and lighting system.

An English syndicate saw the opportunity and organized the Pernambuco Tramway & Power Company, Ltd., which has just completed a modern railway, is constructing an excellent lighting system, and is preparing to reorganize the telephone system. Through the interlocking of the directorates of a number of companies, the English manufacturers secured orders for all equipment except seventy single-truck cars, equipped with motors, which the English bidders could not deliver within the time specified and which were therefore secured from the United States.

But, notwithstanding the fact that Europe has had a practical monopoly of all electrical apparatus sold in Pernambuco, the city remains an excellent field for the sale of motors, fans, fixtures, wiring materials, lamps, electrical specialties and the like. The demand for any one of these lines, however, would not warrant the opening of a branch house in the city by a single manufacturer, a step which would have to be taken in order to meet the competition of European firms that will endeavor to monopolize this market as soon as commercial conditions abroad permit.

If American manufacturers can obtain the permission of this government to form a selling corporation to handle the products of competitive companies, they can undoubtedly make a large success in Pernambuco. Such an organization could handle motors of one company, wiring materials of another, and lamps of a third, together with fixtures and electrical specialties of still another company. In addition, it could handle agricultural implements from several manufacturers, together with steam engines, road-working machinery, electric-railway cars and oil engines from other firms, thus covering the machinery and engineering supply market from practically every angle. A company of this nature would have a large opportunity in Pernambuco, and the margin of profit, after the company should become well established, would be considerable.

A building suitable to accommodate this entire line would cost about $6,000 per year, with a manager to receive a similar salary. Office help would amount to about $4,000, and salesmen would add an equal sum. Experts and incidental expenses would bring the total to about $37,000 per year, which, divided among twenty manufacturers, would enable each to place his goods in the very center of a splendid market for only $2,000 a year.

When it is considered that within the next three years more than $350,000 will be expended in this district for the electrification of cotton mills and other factories alone, the cost is very small indeed, but the opportunity will not remain open long, because the end of the war will see a greater influx of foreign manufacturers into Pernambuco and the surrounding country, eager to make up for their losses during the European struggle. If the United States desires to take advantage of its opportunity, it will have to hurry.

If someone had prophesied six years ago that Rio de Janeiro would have 70,000 hp in motors installed in 1915 he would have been ridiculed. But that is what has come to pass. Who knows but that Pernambuco will have at least one-half of that amount installed in the next half decade? Within three years this city will require material to wire 6000 houses, 1000 arc lamps, 100,000 incandescent lamps, and 200 consumers of electrical energy for motor service will need motors and accessories. All this is on a moderate estimate. The actual material needed will probably exceed this amount. Then material must be bought to build and equip a telephone system of 1500 telephones, and if the proper campaign is made there is no reason why $25,000 of household specialties alone should not be sold within the next three years.

There is plenty of money in the State and in the city to pay for all of this. The average yearly yield of sugar alone is 1,600,000 sacks, valued at $10,000,000, while cotton, castor beans, rubber, skins, cocoa and tobacco bring the total well above $20,000,000 a year.

Pernambuco is one of the richest fields of endeavor still overlooked by North American capital, a field that would yield a rich harvest for the electrical companies that would consent to work it on a co-operative basis.

Several large cotton mills close to the city are operated by steam, but they must change over to electrical energy generated by internal-combustion oil engines if they intend to compete with mills which have already made this change. A German firm installed a 250-hp plant in the Fabrica de Macacheara, which is furnishing power at about 1½ cents per hp-hr. If some wise Yankee does not "beat him to it," the representative of this firm will have the contract for the other mills as soon as conditions permit.

*Former special agent of the Department of Commerce.

A 115,000-Volt Hydroelectric System in Japan—I

Six 10,000-Hp Turbines Operating on 350-Ft. Head—Special Oil and Disconnecting Switches—360,000-Volt Testing Set

WITH its generating station situated on the Nippashi River, the outlet of Lake Inawashiro, Japan, and transmitting energy at 115,000 volts to Tokio, 145 miles distant, the Inawashiro Hydro-Electric Power Company has the distinction of operating the highest voltage system outside the United States. The installation is also of special interest because apparatus supplied by manufacturers in Germany, England, Japan and the United States had to be interconnected. Many of the large pieces of equipment were specially designed so that they might be transported over the narrow-gage Japanese imperial railroad.

General Layout

As arranged at present the system consists of one generating station, containing equipment having a total rating of 46,662 kva, a double-circuit steel-tower transmission line passing through three equally spaced sectionalizing stations, and a receiving substation which contains step-down transformers having a total rating of 48,000 kva. The substation is interconnected with other distributing stations in Tokio. Ultimately three more generating stations will be erected within an interval of six miles to utilize consecutively the drop along the Nippashi River. These stations will be connected by a double-circuit tie line with the existing generating station, where a system operator will be stationed. When this addition is started, another two-circuit transmission line will be erected parallel to the present one leading to Tokio, and the main receiving station will be provided with practically double the equipment it now has.

Generating Equipment

Water impounded in Lake Inawashiro is conveyed to a forebay at the station where a masonry dam furnishes a hydraulic head of 350 ft. The pressure thus provided is utilized in driving six 10,000-hp horizontal Francis water turbines which are directly connected with as many 7777-kva, 6600-volt, three-phase, fifty-cycle generators designed to operate at 375 r.p.m. These units are arranged in a single row along the side of the station away from the incoming penstocks which pass under the transformer, switch and busbar galleries. Dividing the row of generators into two sections is a group of four waterwheel-driven exciters in the center of the engine-room floor. The generator shafts are equipped with vanes which draw air from cold-air ducts and force it through passages which can discharge near the outgoing transmission lines or into the switch galleries during cold weather. The neutral point of each generator, which is star-connected, is joined through a disconnecting switch with a sectionalized busbar, each half of which is grounded through a 3.6-ohm resistor capable of conducting 1050 amp for thirty seconds. The resistors are provided to limit static strains which will exist when lines are crossed or grounded. Ordinarily, one generator is grounded at a time.

The four exciters which are employed are rated at 200 kw, 220 volts, 600 r.p.m., and are driven by 300-hp

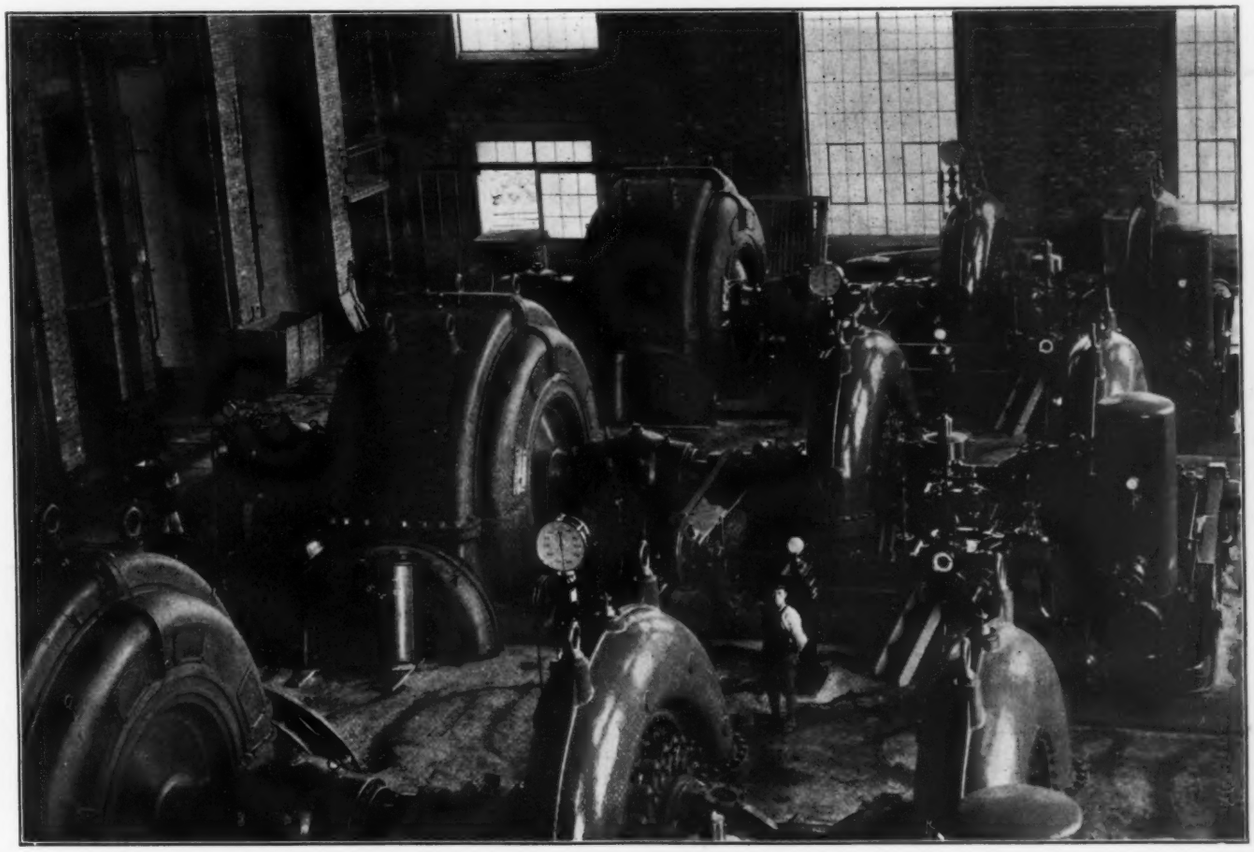


FIG. 1—THREE OF THE SIX 10,000-HP WATERWHEEL GENERATORS

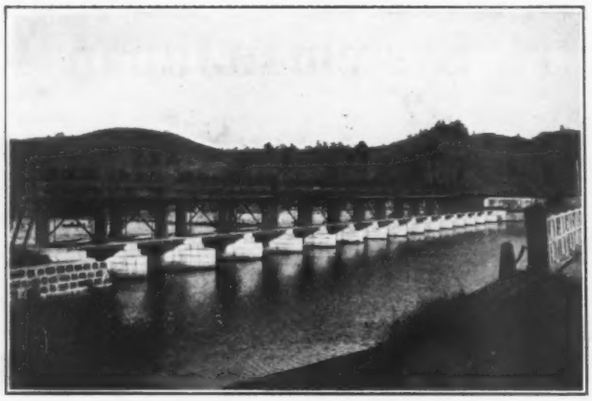


FIG. 2—SLUICEWAY AT OUTLET OF LAKE

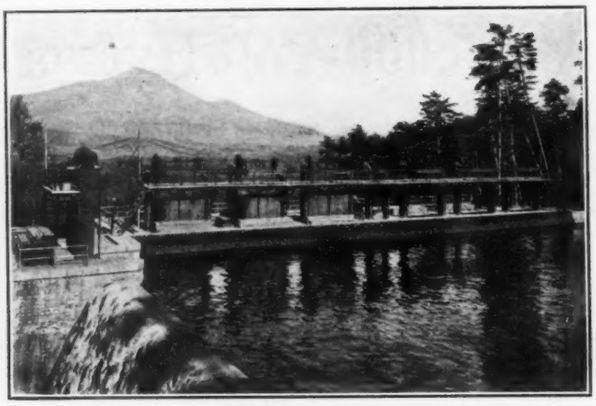


FIG. 3—HEAD TANK AND SLUICEWAY

horizontal-impulse waterwheels. They are connected with duplicate sectionalized busbars through interlocked reverse-power circuit-breakers so that all of the units can be operated in parallel or separately. As each generator is also connected with both busbars through interlocked switches, very flexible means of excitation are provided. The direct-current busbars also furnish energy for emergency lighting and for charging the storage batteries which operate the control equipment.

To control the voltage of the exciters Tirrill regulators are employed. Circuits are arranged so that each of the four regulators provided may be used with any of the four exciters or any grouping thereof. Remote-controlled rheostats are connected in the field circuits of each generator so the voltage can be regulated by hand, when so desired, in which case the regulator resistor is short-circuited. As the voltage of the exciters will tend to rise abnormally when a line is short-circuited or when a circuit-breaker is opened suddenly, automatically operated relays were provided to insert resistance in the exciter field circuits when such conditions exist.

Generator and Auxiliary Busbars

From each generator cables pass through ducts in the floor to disconnecting switches and oil switches back of the transformers and thence to the main 6600-volt busbars and auxiliary busbars on the gallery above. The main busbars, which are arranged in a loop, are sectionalized by disconnecting switches between each circuit connected thereto. Two oil switches are also provided to divide the loops into two sections. The main busbars feed step-up transformers as well as the station-service transformers. A water rheostat is also connected thereto for loading any machine. The auxiliary busbars are also sectionalized but are straight and arranged to energize 6600-volt outgoing feeders. Indoor-type aluminum-cell lightning arresters are connected through horn-gaps with the outgoing 6600-volt feeders. Zigzag multiple gaps connected in series with

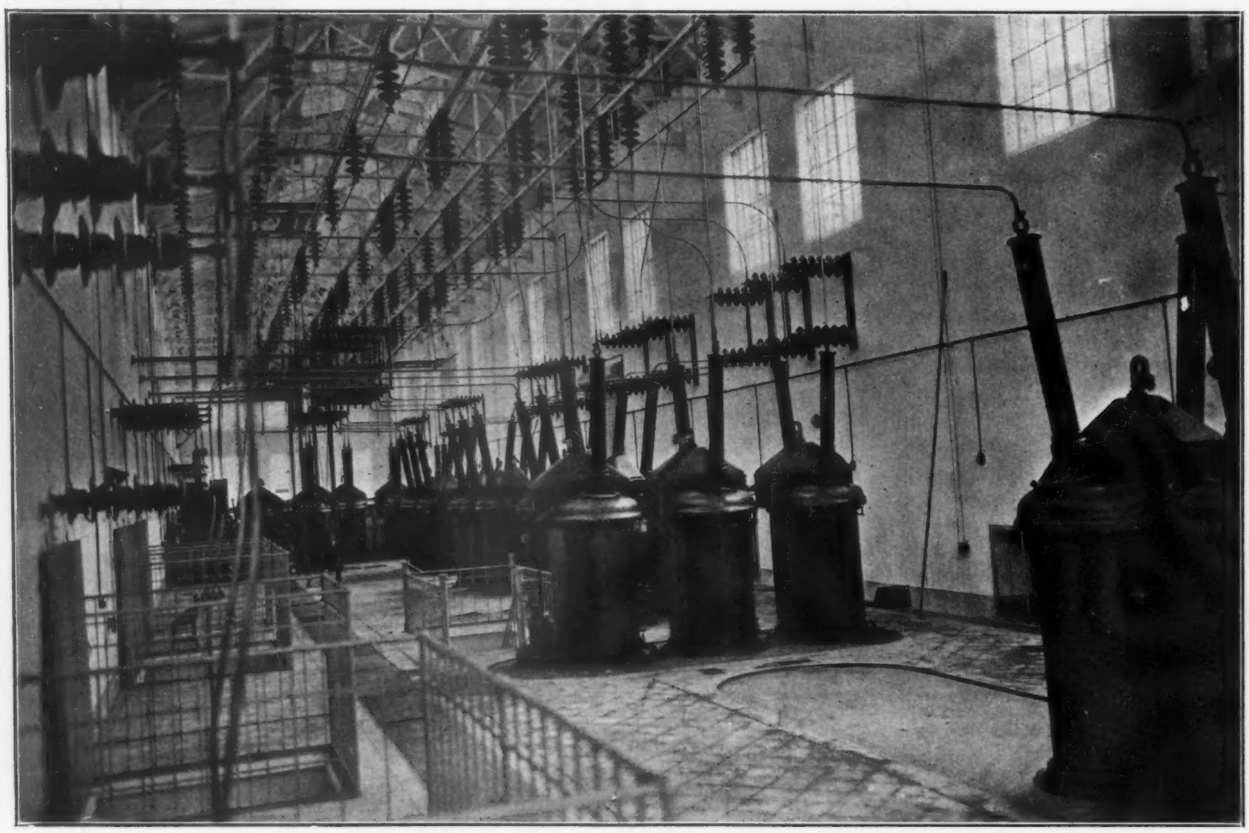


FIG. 4—115,000-VOLT BUSBARS AND OIL SWITCHES

resistors are inserted between the low-voltage terminals of the main transformers and ground to protect them from static disturbances caused by arcing grounds on the 115,000-volt system, etc.

Step-Up Transformers

The step-up transformers consist of four banks of three 4400-kva, single-phase, water-cooled, oil-insulated, 6600/115,000-volt units connected in delta on both sides. They are mounted on trucks housed in individual masonry compartments along one side of the generating room, into which they can be transferred when overhauling is necessary.

Shell-type magnetic circuits are employed, and both high-voltage and low-voltage windings are made of flat coils having one turn per layer. Insulation on the coils nearest the terminals has about three times the strength of that on the intermediate coils. The insulation as a whole is designed to withstand double-rated voltage for five minutes.

Although designed for water-cooling, the transformers will operate satisfactorily without any circulation of water provided full load is not carried more than four hours, or one-half load more than eight hours. The transparent amber-colored mineral transformer oil employed has a flash point of 170 deg. C., a fire point of 190 deg. C., specific gravity of 0.86, and a dielectric strength of 30,000 volts between a 0.15-in. sphere gap.

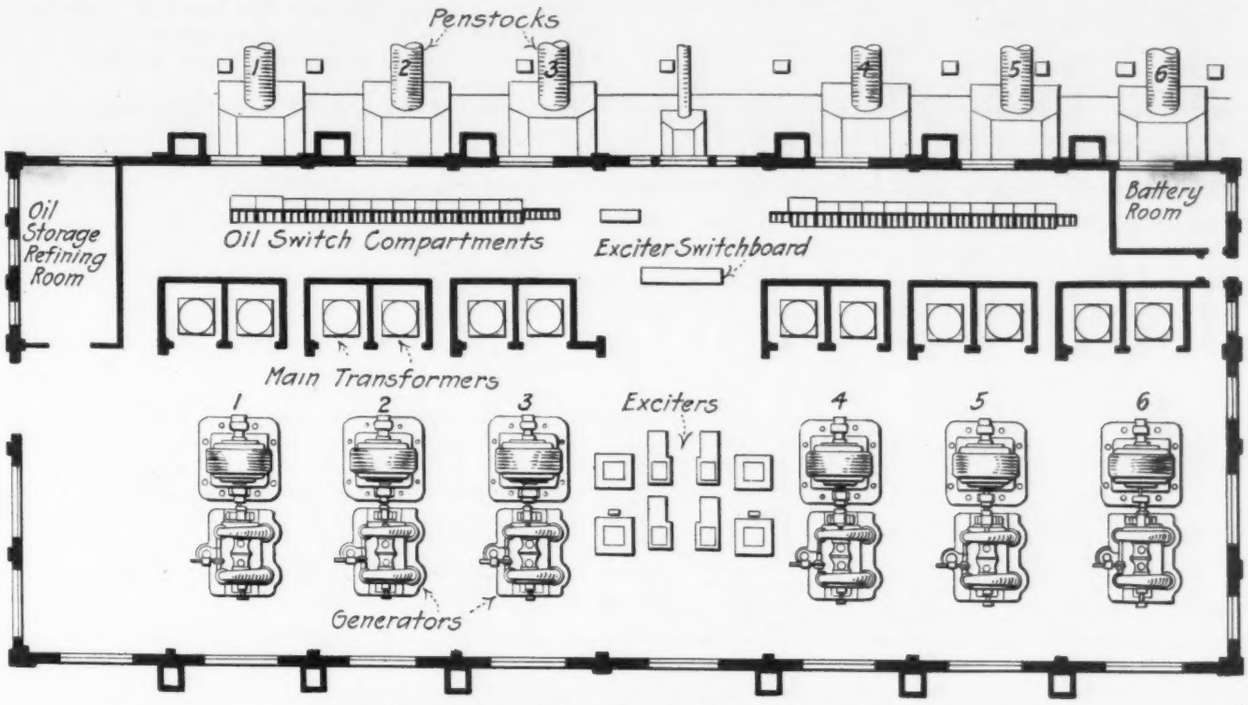


FIG. 5—PLAN OF MAIN FLOOR IN GENERATING STATION

Spare parts are kept in stock at the station so repair work does not have to be delayed by waiting for new parts from the manufacturers in America. The reserve set includes assembled high-voltage and low-voltage coils and a complete set of unassembled parts for both coils. In case a transformer is damaged, the entire winding may be removed and replaced by a serviceable set. When more time is available the damaged coil can be repaired by replacing faulty sections with units from the unassembled set.

Condenser-Type Terminals

One of the most important features of the high-voltage equipment is the use of condenser-type terminals for roof bushings and for the oil-immersed equipment. Each terminal consists of a metallic core, serving as the conductor, surrounded by alternate layers of shellac-

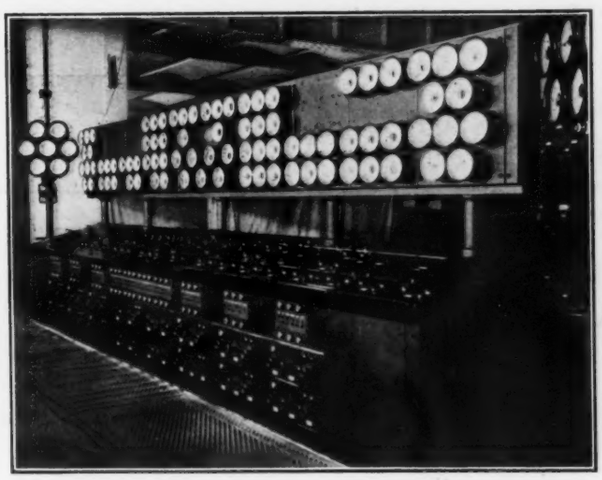


FIG. 6—MAIN-CONTROL BENCHBOARD AND INSTRUMENT BOARD

FIG. 7—BANK OF THREE 6600/115,000 VOLT TRANSFORMERS

coated micarta paper and tinfoil which grade off in length from the inner cylinder to the outer shell. Around the outer layer is a metallic cylinder consisting of closely wound wire soldered together. The end of the terminal that is not immersed in oil is inclosed in a casing of bakelite micarta, the intervening space being filled with insulating compound. Static shields are at-

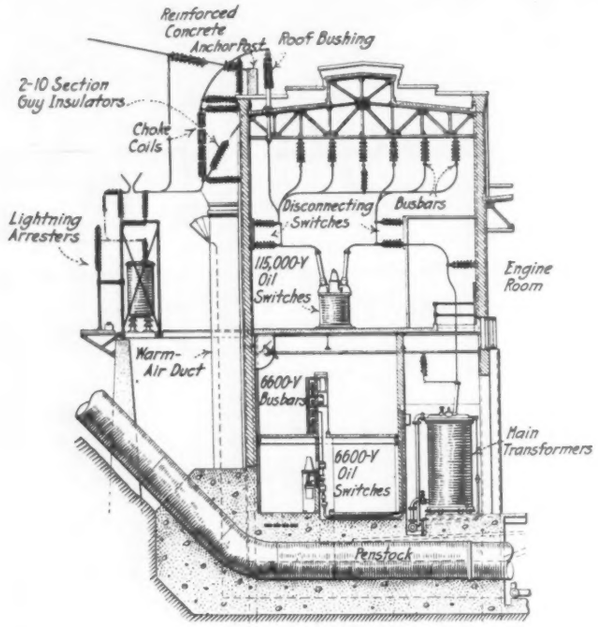


FIG. 8—TRANSVERSE CROSS-SECTION OF GALLERIES

tached to the end of each casing for the purpose of preventing corona discharge.

115,000-Volt Busbars

The 115,000-volt terminals of each bank of transformers are connected by copper tubing attached to six-section insulators suspended from the ceilings of the compartments. From these busbars tubes extend up through openings in the floor of the high-voltage gallery to oil switches, thence to disconnecting switches, and finally to copper-tube loop-type sectionalized busbars attached to six-section insulators suspended from the roof trusses. Like the 6600-volt busbars, they are divided by disconnecting switches into as many sections as there will be circuits connected thereto. Three oil switches further subdivide the busbars into three sections with one pair of transmission lines (future and installed) on each.

From the high-voltage busbars two circuits lead to disconnecting switches, thence through oil switches over to other disconnecting switches on the opposite wall from those first mentioned, and out through condenser-type roof bushings.

FIG. 9—EXCITER SWITCHBOARD WITH SOLENOID-OPERATED SWITCHES

High-Voltage Disconnecting and Oil Switches

The high voltage disconnecting and sectionalizing switches are attached to rigid built-up porcelain columns, some of which are supported in horizontal positions and others vertically. The columns of indoor sets contain six sections, while those for outdoor use have ten. It has been reported that a force of 1000 lb. transverse to the length is required to break such a column. The outdoor type will stand 287,000 volts in a rain test, while the flash-over pressure between columns in dry weather is 375,000 volts.

Each pole of the 115,000-volt oil-immersed circuit-

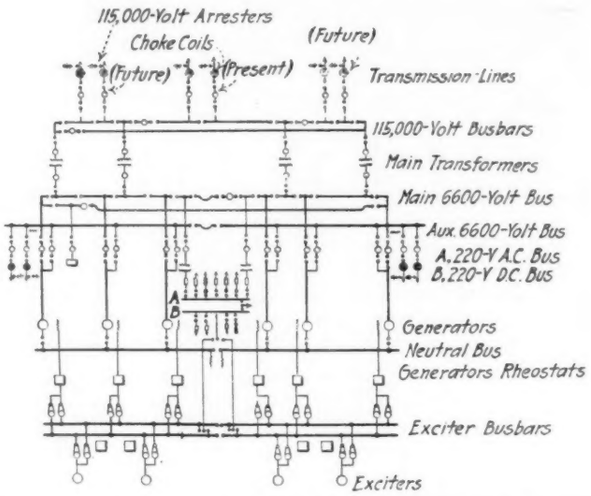


FIG. 10—ONE-LINE DIAGRAM OF ELECTRICAL CONNECTIONS

breakers is installed in its individual welded-steel tank, the moving parts being operated simultaneously by a system of levers and links actuated by a horizontal rod extending through the heads of the tanks and connected with a single solenoid. The stationary contacts are screwed directly to the ends of the brass tubes extending through the condenser-type bushings. Series transformers, operating ammeters and relays are clamped directly around the bushing leads inside the tank. Such an arrangement permits the use of a simple, compact and relatively inexpensive form of current transformer.

High-Voltage Outdoor Equipment

The roof bushings are similar to the transformer terminals except that the micarta end casings are replaced by a series of brown-glazed porcelain shields cemented together to form a practically continuous porcelain tube. From the tops of these bushings conductors curve

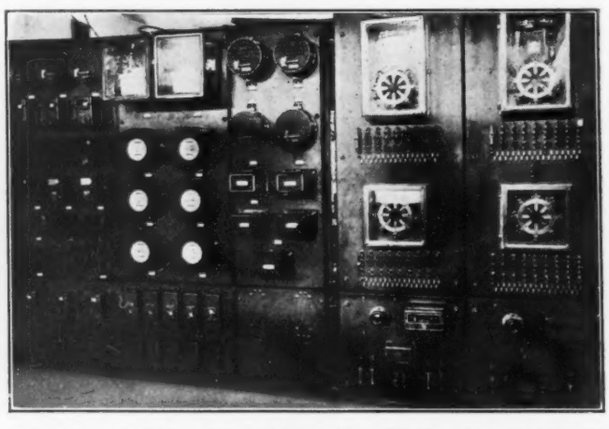


FIG. 11—PORTION OF REGULATOR, RELAY AND RECORDING WATT-HOUR-METER BOARD

downward to special choke coils supported near the edge of the roof in a vertical position by horizontally projecting and specially guyed built-up insulators. The lower ends of these choke coils are connected with the joining the neutral with the ground. Auxiliary horn-gaps shunted by glazed carborundum-rod resistors are furnished to prevent surges when the arresters are being charged. Although the electrolytic cells are de-

HYDRAULIC DATA

Source of Water Supply	Water Conduits Leading to			Protection Against Excessive Pressures
	Forebay	Station		
		For Generators	For Exciters	
Lake Inawashiro.....	Open canal, closed canal, tunnel and flume	Six 75-in. to 87-in. dia. welded-steel pipes 1420 ft. long	One 25.5-in. to 31.5-in. dia. welded-steel pipe 1420 ft. long	Relief valves for each turbine

MAIN WATERWHEELS

No.	Hp (Each)	R.p.m.	Head (Ft.)	Position of Shaft	Type	Connection with Generator	Manufacturer	Headgate Control	Speed Regulation
6	10,000	375	350	Horizontal	Francis	Direct	J. N. Voith	Remote electrical	Remote electrical

MAIN GENERATORS

No.	Voltage	Phases	Frequency	R.p.m.	Kva	Manufacturer	Method of		Rating of Generator Reactors
							Grounding Generators	Ventilating	
6	6600	3	50	375	7777	Dick, Kerr & Co.	Connected with sectionalized neutral bus grounded through 3.6-ohm resistors	Vanes on generator shaft	None

EXCITERS					DRIVER			VOLTAGE REGULATORS		
No.	Voltage	R.p.m.	Kw	Manufacturer	Type	Hp (Each)	Manufacturer	No.	Type	Method of Preventing Abnormal Voltage Rise
4	220	600	200	Dick, Kerr & Co.	Horizontal-impulse waterwheels	300	J. N. Voith	4	Tirrill	Automatically insert resistance in field

TRANSFORMERS

No.	Kva	Phases	Voltage		Connections		Type	Manufacturer	Use
			Low	High	Low	High			
12	4400	1	6600	115,000	Δ	Δ	O-I. W-C.	West.	Feed transmission
2	150	3	220-110	6,600	Δ	Δ	O-I. W-C.	West.	For station service

PROTECTIVE EQUIPMENT

No. Sets	Type	Manufacturer	Arrangement	Connected with	Location
2	Single-phase electrolytic cells with horn-gaps and choke coils	West.	Three cells in star; neutral grounded through a fourth cell	115,000-volt transmission lines	Outdoors
4	Single-phase electrolytic cells with horn-gaps and choke coils	West.	Two cells across each three-phase circuit	6600-volt feeders	Indoors

dead-ended transmission lines and through horn-gaps with outdoor-type aluminum-cell lightning arresters.

Each set of lightning arresters consists of four single-phase cells supported on insulators, three of the units being connected in star with the lines, and the fourth signed for a high discharge rate, they are equipped with fuses that will rupture in case a discharge continues long enough to overheat the arresters considerably.

Each 115,000-volt lightning arrester unit consists of two three-section columns of telescoping aluminum

trays inclosed in micarta shields and submerged in tanks containing oil. The columns are connected in series, one terminal extending through an insulating bushing at the top of the case, while the other is grounded to the metallic case. As protection from lightning is seldom required in severely cold weather, special oil with a low freezing point is not employed in the lightning arresters.

Main Control Equipment

The main control board, which is of the desk type, is on a gallery overlooking the generator room. The central section of the board contains the control equipment for the exciters, the low-tension bus-tie circuits and two local service circuits. The sections at the extreme right and left end control 6600-volt outgoing feeders, while the six remaining panels bear apparatus controlling the generators, transformers and incoming and outgoing 115,000-volt lines (both future and installed). Only instruments which are required in operating the station equipment are installed on the vertical panels over the desk. To facilitate calibrating these instruments, test terminals have been provided on the back of the board. On the front of the desk are six-button gang switches and indicating lamps for signaling operators at each generator and exciter. Similar signaling equipment is installed on pedestals beside each waterwheel so that the attendant can answer the signals sent from the control board. As both the positive and negative direct-current busbars are at the desk and near the pedestals, only one wire is required for each signal circuit.

Headgate control switches and indicating lamps are also placed on the control board. To open the gates the controllers must be held in the opening position, otherwise they will return automatically to the neutral point. When closing a gate, however, it is unnecessary to keep the hand on the controller as it will stay in the closing position, a limit switch automatically stopping the headgate motor. Overload relays are provided to protect the motors in case they become stalled. To pre-

SWITCHES IN EXCITING CIRCUIT

No. Sets	Rating (Amp)	Type	Location	Relay Type
4 pairs	1000	Two-pole S-T. carbon break solenoid operated	Between exciters and duplicate bus bars	Interlocked O-L. R-P. D-T.
2	1000	Two-pole S-T.	Between bus sections	Non-automatic
2	200	Two-pole S-T	Selector for station bus	
6 pairs	1000	Two-pole S-T. Solenoid-operated	Between generators and duplicate exciter busbars	Interlocked non-automatic

6600-VOLT SWITCHES

No. Sets	Rating (Amp)	Type	Location	Relay Type
6 6 6	1200	Disc. Oil Disc.	Between generators and main busbars	O-L. R-P. D-T
6 6 6	1200	Disc. Oil Disc.	Between generators and auxiliary busbars	O-L. R-P. D-T.
4 4	1200	Disc. Oil	Between main bus and main transformer	O-L. I-T. and differential
2 2	600	Disc. Oil	Between main bus and station transformer	O-L. I-T. and differential
4 4 4	600	Disc. Oil Disc.	Between auxiliary bus and 6600-volt feeders	O-L. I-T.
15	2000	Disc.	Between main bus sections	None
2	2000	Oil	Divide main bus	Non-automatic
2	1200	Disc.	Divide auxiliary bus	None

115,000-VOLT SWITCHES

No. Sets	Rating (Amp)	Type	Location	Relay Type
4 4	300	Oil Disc.	Transformer to bus	O-L. I-T. and differential
3 13	300	Oil Disc.	Sectionalize bus	Non-automatic
2 2 2	300	Disc. Oil Disc.	Bus to transmission lines	O-L. I-T.

EXCITER BUSBARS

No. Sets	Arrangement	Rating (Amp)	Connected with
2	Two-section straight	1000	Generators and station-service system

6600-VOLT BUSBARS

No. Sets	Arrangement	Rating (Amp)	Material	Connected with	Rating of Bus Reactors
1	13-section loop	2000	Strap copper	Main and station transformers	None
1	Two-section straight	1200	Strap copper	6600-volt feeders	None

115,000-VOLT BUSBARS

No. Sets	Arrangement	Rating (Amp)	Material
1	10-section loop	300	0.75-in. copper tube

MISCELLANEOUS EQUIPMENT

Testing apparatus includes the following Westinghouse equipment:
- One 150-kva, 6600/2000-volt regulating transformer with 0-2000-volt taps.
- One combined motor-driven drum switch and induction regulator with range of 0-2000 volts.
- One 150-kva, 2000/360,000-volt testing transformer.
- One 2000-volt oil-immersed reactor in series with low-voltage winding of testing transformer.
- One 500,000-volt sphere spark-gap.

Storage battery consists of E-11 Tudor cells rated at 100 amp-hr., 220 volts, in series

Oil-handling apparatus comprises the following Westinghouse equipment:
- One motor-driven plunger pump.
- One oil filter.
- One oil-testing cup.

vent operators continually closing a switch after the overload breaker opens, as would probably occur if the relays were reset by remote control, the relays have been installed on a panel near the headgates where they have to be reset by hand. Master switches operating

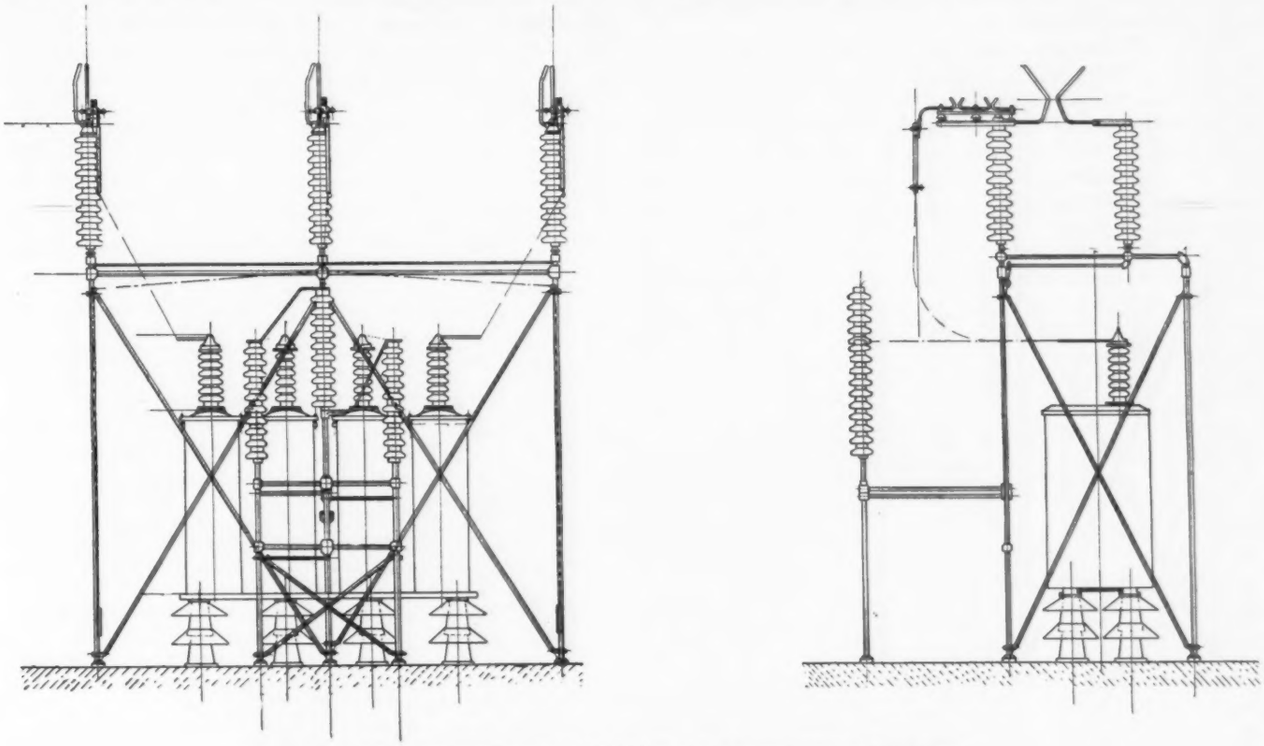


FIG. 12—OUTDOOR-TYPE 115,000-VOLT LIGHTNING ARRESTERS

1/6-hp series motors on the valves of the waterwheels are employed to regulate the speed of the turbo-generators.

Line-drop compensators have been provided so that

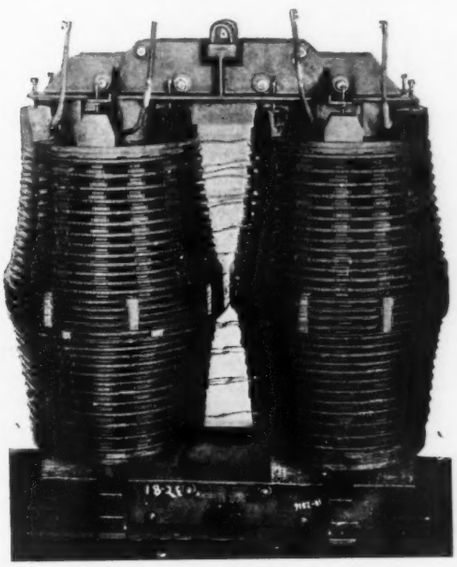


FIG. 13—CONSTRUCTION OF 360,000-VOLT TESTING TRANSFORMER

the receiving-station voltage can be read on the generating-station instruments. In order that it shall not be necessary to synchronize on the 115,000-volt side of the transformers, the synchronizing receptacles have been connected with the low-voltage terminals. The receptacles are equipped with auxiliary contacts so that it is impossible to close a circuit-breaker before inserting the synchronizing plug. Miniature dummy busbars and pilot lamps are laid out on the panels to indicate the connections and positions of switches.

Temperature, Water-Circulation, Arrester-Discharge and Ground Indicators

In the room adjacent to the control desk are three twelve-drop annunciators. One is connected with a thermometer-signal device on each of the main transformers to indicate when the temperature on any one of the units exceeds a predetermined limit. The second annunciator indicates when the circulation of cooling water is interrupted in any one of the transformers. The third indicator is connected with the 6600-volt and 115,000-volt lightning arresters so that a bell is rung and indication given when there is a discharge through any of the arresters.

Four 6600-volt, three-phase static ground indicators are mounted above the busbar compartments to indicate the existence of grounds on either section of the auxiliary or main busbars.

Relay and Watt-Hour-Meter Board

On the same floor with, but back of, the main control board is a board which supports all of the relays, watt-hour meters and recording graphic meters. Test terminals are provided for calibrating the instruments on this board. Overload reverse-power definite-time relays are connected with circuit-breakers in exciter, generator and incoming transmission circuits. Overload inverse-time-limit relays are employed with circuit-breakers in all outgoing and transformer circuits. Transformers are protected from internal trouble by differential instantaneous relays. Breakers in the tie and generator-field circuits are non-automatic.

Exciter and Station-Service Switchboards

The exciter switchboard which is on the main floor under the control switchboard supports twelve two-pole

solenoid-operated interlocked field discharge switches, eight two-pole solenoid-operated circuit-breakers provided with overload and reverse-power definite-time-limit relays which are interlocked, watt-hour meters, and various feeder knife switches which are equipped with padlocks to prevent their being opened or closed by unauthorized persons.

The station-service switchboard and apparatus controlling high-voltage testing equipment is installed near the exciter switchboard. The equipment on the service board controls two 150-kva, three-phase, 220/110/6600-volt service transformers, distributing circuits and other apparatus. Mounted at the top of one of the panels are relay-controlled contactors which automatically connect an emergency lighting circuit with the control-circuit storage battery when the alternating-current energy which is normally employed is not available. When alternating-current service is restored, the lighting circuit is again connected to the normal supply. As on the exciter switchboard, some of the switches are equipped with padlocks to prevent unauthorized operation.

FIG. 14—OUTGOING 115,000-VOLT LINES AND LIGHTNING ARRESTERS

The high-voltage testing equipment controlled from the panel next to the service switchboard includes one 150-kva, 6600/2000-volt regulating transformer, one combined motor-driven drum switch and induction regulator for varying the voltage delivered by the regulating transformer from zero to 2000 volts, a 150-kva, 2000/360,000-volt testing transformer, a 2000-volt oil-immersed reactor connected in series with the low-voltage side of the testing transformer, and a 500,000-volt sphere gap limiting the voltage impressed across the apparatus being tested. The testing transformer was briefly described on page 1273 of the May 30, 1914, issue of the ELECTRICAL WORLD.

To operate the control equipment a 110-cell E-11 Tudor storage battery is employed. It is designed to discharge at the rate of 100 amp for an hour or 200 amp for twenty minutes. Although the battery is normally connected with 110 cells in series, switches are provided on the service board to permit connecting two groups of fifty-five cells in parallel so that they can be charged from any of the exciters running at reduced voltage with a resistor in series. Charging the battery in parallel will not prevent the operation of the indicating or emergency lamps as they are rated at 110 volts and connected across a three-wire system, whose neutral is joined with the mid-point of the battery. With all of the cells connected in series the battery can float on the system with one or more exciters, the difference in voltage being taken up by the charging rheostat. A reverse-power relay is connected in series with the battery when operating in this manner, so that it will not feed back into the exciter system but will continue supplying the control circuit.

Mr. Ralph D. Mershon, consulting engineer, 80 Maiden Lane, New York City, designed the general engineering features of the entire plant and supervised the construction and tests of equipment before delivery to Japan. The design of that portion of the generating station used for waterwheels, generators and exciters was based largely on drawings prepared by Kennedy & Jenkin, of London; J. N. Voith, of Heidenheim, Germany, furnished the turbines, valves, etc.; Dick, Kerr & Company, of England, supplied the generators, exciters and regulators; the Westinghouse Electric & Manufacturing Company manufactured the transformers and switching equipment; the American Bridge Company supplied the steel transmission towers; R. Thomas & Sons Company furnished the insulators; both the transmission towers and the insulators were supplied through Mitsui & Company of Tokio and New York City, and Takata & Company, 50 Church Street, New York City, supervised the installation and local testing of Westinghouse equipment.

Descriptions of the transmission system, intermediate sectionalizing stations and receiving station will be printed in later issues of the ELECTRICAL WORLD.

Torsional Strengths of Guy Anchor Rods

Methods of Proportioning Shafts to Withstand Stresses to Which They Are Subjected While Being Screwed Into the Ground

BY TERRELL CROFT

THE rod of any guy anchor that is screwed into the earth is subjected to torsion while the head is being inserted; that is, while it is being installed. Where the earth is hard it often happens that the metal in the rod is stressed much more severely by the torsional strains that occur while the anchor is

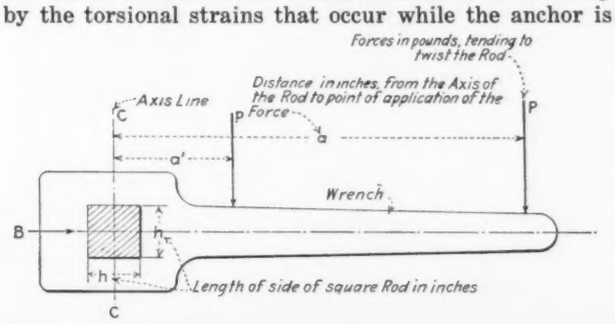


FIG. 1—ILLUSTRATING NOTATION FOR FORMULA FOR TORSIONAL STRENGTH OF SQUARE ROD

being thus installed than it is by the tensile strains ultimately imposed on the rod when the guy-wire pull that it was placed to hold is imposed on it. It follows, then, that the rods of such guy anchors should always be so proportioned as safely to withstand the torsional stresses to which they will be subjected while the anchor is being screwed into the earth.

Experience has indicated that where the rod has sufficient cross-sectional area to insure its being screwed into the earth without being twisted asunder it will have ample tensile strength. If the anchor at its lower end is buried at the usual depth, such a rod will pull the anchor out of the earth when an excessive tensile strain is imposed upon it before it will break or "pull in two."

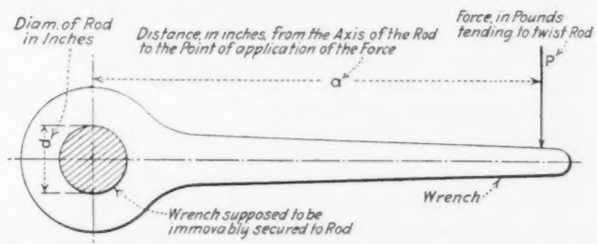

Diam. of Rod in Inches
Distance, in inches, from the Axis of the Rod to the Point of application of the Force
Force, in Pounds tending to twist Rod
a
P
d
Wrench
Wrench supposed to be immovably secured to Rod

FIG. 2—NOTATION FOR TWISTING STRENGTH OF ROUND ROD

It is interesting to make a numerical comparison of the relative torsional strengths of anchor rods of different sizes and shapes, and fortunately this is not difficult to do. All of the guy anchor rods that are in commercial use are either round or square. In Kent's "Mechanical Engineer's Pocket Book," sixth edition, are given simple formulas whereby the torsional strengths of either round or square rods can readily be computed. A comparison such as that suggested will be made and the general situation relating to torsional stresses as it affects guy rods will be discussed in the following paragraphs.

The torsional strength or resisting moment of a rod or bar must be expressed as a "moment"; that is, as the product of pounds multiplied by distance, or in "pound-inches." The reason for this will be apparent from a consideration of Fig. 1. It can readily be appreciated that, while the bar B would probably be strong enough to resist being twisted asunder by a force of a certain number of pounds applied at p a short distance a' from the axis line CC' of B, it might not be strong enough to resist being twisted asunder by the same force of the same number of pounds applied at a relatively great distance a from CC'. The torsional strength of a rod is, then, expressed as a resisting moment.

Suppose that the torsional resisting moment of the bar B of Fig. 1 is just 10,000 lb.-in. This would mean that the rod would resist the twisting effect of a force of 1000 lb. applied a distance of 10 in. from the axis of the rod. That is, if the resisting moment in pound-inches be divided by the pounds force applied, the maximum distance from the axis at which the force can be safely applied will be the result. The force in pounds may have any value, provided it is applied at such a distance from the axis that the product of pounds multiplied by distance from axis equals the resisting moment.

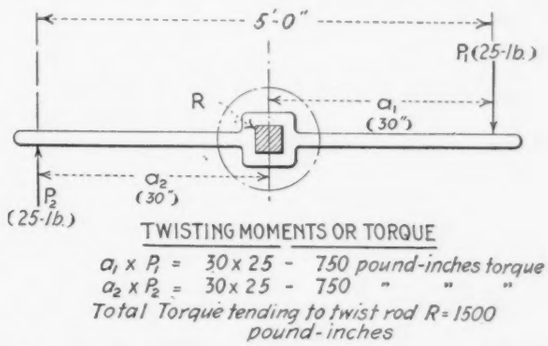


FIG. 3—TORQUE EXERTED BY TWO MEN PUSHING ON ENDS OF 5-FT. WRENCH

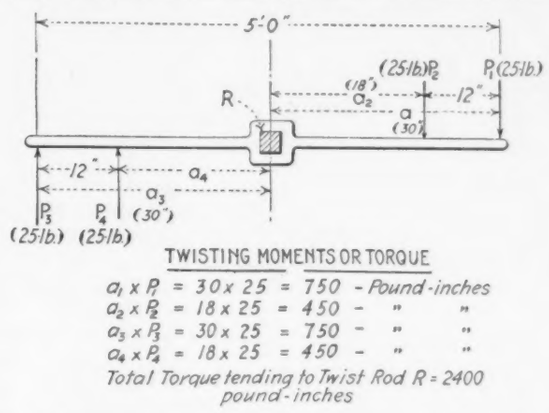


FIG. 4—TWISTING MOMENT EXERTED BY FOUR MEN PUSHING ON WRENCH

Threading a rod decreases its torsional strength—and its tensile strength also. Obviously, threading decreases the effective cross-section or area of a rod, and since both the tensile and the torsional strengths are determined by the cross-sectional area, a decrease in the area involves a decrease in the strength. Further-

more, as shown in the following formulas for torsional strength, this strength varies as the cube of the diameter in the case of a round rod, or the cube of the length of a side in the case of a square rod. Hence a small decrease in the sectional area, due to threading, causes a large decrease in the torsional strength.

In computing the torsional strength of a threaded rod the effective diameter must be taken as the diameter at the root of the thread. This "root" diameter can be ascertained for standard screw threads by the tables giving properties of screw threads in handbooks such as Kent's.

The formula for the torsional strength or resisting moment of a round rod is:

$$R = 0.1963 \times d^3 \times S,$$

wherein R = the resisting moment or resisting ability of the rod to torsion, in pound-inches, d = the diameter of the rod in inches (see Fig. 2), S = the unit shearing resistance of the material of the rod in pounds per square inch.

The formula for the torsional strength or resisting moment of a square rod is:

$$R = 0.2222 \times h^3 \times S,$$

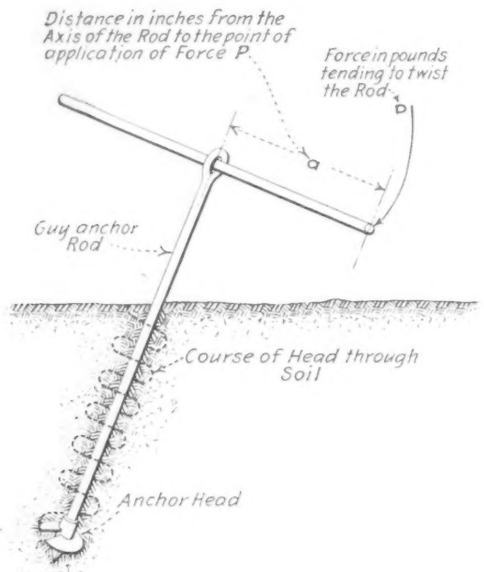

Distance in inches from the Axis of the Rod to the point of application of Force P.
Force in pounds tending to twist the Rod
Guy anchor Rod
Course of Head through Soil
Anchor Head

FIG. 5—ILLUSTRATING TWISTING MOMENT IMPOSED ON ANCHOR ROD WHILE TWISTING IT IN

wherein the letters have the same meaning as in the round-rod formula except that h = the length of each of the sides of the square bar in inches as shown in Fig. 1.

A twisting moment or a torque is a measure of the tendency to produce rotation. It may be considered as opposite to and opposed by the resisting moment. This tendency can be measured in pound-inches, as can a resisting moment. The formula for twisting moment is:

$$T = P \times a,$$

wherein T = the twisting moment in pound-inches, P = the force in pounds tending to twist the rod, a = the distance in inches from the axis of the rod to the point of application of the force P.

For example, if in Fig. 1 the distance a were 36 in. and the force or push P were 100 lb., the twisting moment or torque would be: $100 \times 36 = 3600$ lb.-in. If a were 20 in. and P were 76 lb., the twisting moment would be: $20 \times 76 = 1520$ lb.-in. Fig. 2 shows the application of the quantities a and P to the case of torsion of a round rod.

When several forces tend to rotate an object the twisting moment is equal to the sums of the twisting moments of each separate force. For example, the simple computation indicated on Fig. 3 shows how the twisting moment due to two forces tending to rotate a bar—that is, to screw a guy anchor into the earth—are ascertained. Each of the arrows P_1 and P_2 represents a man pushing on the handle at a distance of 30 in.

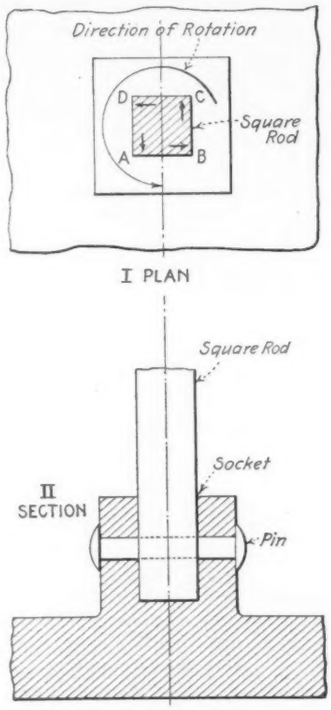


FIG. 6—SQUARE ROD SET IN SOCKET

from the axis. A man can push with an average horizontal force of about 25 lb. (Kent). Hence the twisting moment due to each man is 750 lb.-in., and the total twisting moment due to the force or push exerted by two men is 1500 lb.-in.

Similarly the twisting moment due to the push of four

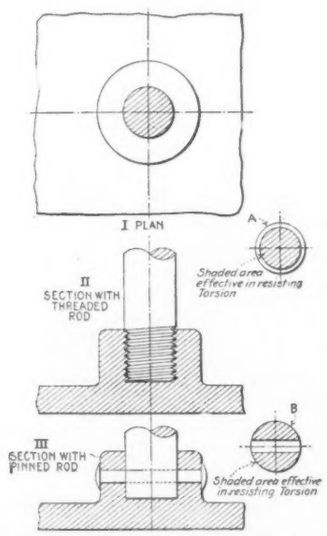


FIG. 7—ROUND RODS SET IN SOCKET

men, assuming a force of 25 lb. per man, is computed in the example shown in Fig. 4.

The twisting moment or torsional strength of guy-anchor rods of different shapes and proportions is given in Table I. All of these values are computed on the basis of an ultimate shearing strength of 50,000 lb. per

sq. in., so that a comparison of the values in column *c* will indicate the relative strengths of the different sections. In computing the strength of the round rods it has been assumed in every case that the rods are threaded, because where round rods are used in anchors they are usually threaded. The values of resisting

TABLE I
SHOWING TORSIONAL STRENGTHS OR RESISTING MOMENTS OF SOME STANDARD SIZE GUY ANCHOR RODS
Shearing Strength, S, of Material assumed to be 50000 lb. per square inch

No.	Shape and Dimensions of Rods	Formula and Operation for Computing Resisting Moment	Resisting Moments or Torsional Strengths in pound-inches
1	.0837" 1" 1" Round Rod Threaded	$R = 0.1963 \times d^3 \times S$ $R = 0.1963 \times (.0837 \times .0837 \times .0837) \times 50{,}000$ $R = 0.196 \times 0.585 \times 50000$ $R = 0.115 \times 50{,}000$ $R = 5{,}750$ pound-inches	5,750
2	1" 1" 1" Square Rod	$R = 0.2222 \times h^3 \times S$ $R = 0.222 \times (1 \times 1 \times 1) \times 50{,}000$ $R = 0.222 \times 1 \times 50{,}000$ $R = 11{,}100$ pound-inches	11,100
3	.940" 1⅛" 1⅛ Rd. Rod Threaded	$R = 0.1963 \times d^3 \times S$ $R = 0.196 \times (.094 \times .094 \times .094) \times 50{,}000$ $R = 0.196 \times .083 \times 50{,}000$ $R = 0.165 \times 50{,}000$ $R = 8{,}650$ pound-inches	8,650
4	1⅛" 1⅛" 1⅛" Square Rod	$R = .02222 \times h^3 \times S$ $R = 0.222 \times (1.125 \times 1.125 \times 1.125) \times 50{,}000$ $R = 0.222 \times 1.42 \times 50{,}000$ $R = 0.315 \times 50{,}000$ $R = 15{,}750$ pound-inches	15,750
5	1.065" 1¼" 1¼" Round Rod Threaded	$R = 0.1963 \times d^3 \times S$ $R = 0.196 \times (1.065 \times 1.065 \times 1.065) \times 50{,}000$ $R = 0.196 \times 1.21 \times 50{,}000$ $R = 0.237 \times 50{,}000$ $R = 11{,}850$ pound-inches	11,850
6	1¼" 1¼" 1¼" Square Rod	$R = .02222 \times h^3 \times S$ $R = 0.222 \times (1.25 \times 1.25 \times 1.25) \times 50{,}000$ $R = 0.222 \times 1.95 \times 50{,}000$ $R = 0.433 \times 50{,}000$ $R = 21{,}650$ pound-inches	21,650
7	1.284" 1½" 1½" Round Rod	$R = 0.1963 \times d^3 \times S$ $R = 0.1963 \times (1.284 \times 1.284 \times 1.284) \times 50{,}000$ $R = 0.196 \times 2.22 \times 50{,}000$ $R = 0.435 \times 50{,}000$ $R = 21{,}750$ pound-inches	21,750
8	1½" 1½" 1½" Square Rod	$R = .02222 \times h^3 \times S$ $R = 0.222 \times (1.5 \times 1.5 \times 1.5) \times 50{,}000$ $R = 0.222 \times 3.38 \times 50{,}000$ $R = 0.750 \times 50{,}000$ $R = 37{,}500$ pound-inches	37,500

FIG. 8—COMPARATIVE TORSIONAL STRENGTHS

moments shown in Table I were computed by using the formulas given in preceding paragraphs.

For example, the resisting moment of a threaded 1-in. round rod to torsional strain is 5750 lb.-in. Theoretically, then, this rod would withstand a torque or twisting moment of 5750 lb.-in. It would withstand a rotational force of 575 lb. applied 10 in. from the axis of rotation, or it would withstand a force of 57.5 lb. applied 100 in. from the axis of rotation, etc. But if a torque greater than 5750 lb.-in. were imposed on the rod, it would break. In practice it would be unsafe to impose a load of 5750 lb. on the rod, because it would then be stressed to the breaking point and would probably fail. An ample factor of safety, of probably four, should be allowed; that is, in every case a guy-anchor rod should have at least four times the strength that it will likely be called upon to sustain in order to provide for irregularities in materials and similar contingencies which cannot be predetermined.

The values in Table II indicate that the torsional strength of the 1⅛-in. square rod is 2.74 times as great as that of the 1-in. round rod. Likewise, similar comparisons can be made for rods for guy anchors of other diameters.

A square rod is much better adapted for fastening in an anchor head than a round one. Consider first the square rod set in the head of Fig. 6. Even if the end of the rod is set down in the socket and no pin is placed in it, the rod cannot turn (the socket being held stationary) because the walls of the socket against which the sides of the rod bear prevent any movement. If a twisting force is applied to this square rod, the sides of its end in the socket will press against the walls of the socket as shown by the small arrows in Fig. 6.

Consider now a round rod in a socket, as illustrated in Fig. 7. It is evident that where the rod is threaded, as at II, only the area *A* at the root of the thread is effective in resisting torsion. Of course, this root area is considerably smaller than the entire area of the rod. Since that metal near the circumference of the rod is most effective in resisting torsion, the torsional strength of a rod is materially decreased by threading.

Now suppose a round unthreaded rod be held from turning by a pin through it as at III. Then the area of the rod effective in resisting torsion is that shown at *B*. The rectangular area representing the pin must be taken from the area of the circle to get the effective area. Furthermore, it is in the case of III the shearing

TABLE II
TORSIONAL RATIOS OF STRENGTH

Section No.	Section	Ratio of Resisting Moments
2 1	1" 1"	$\frac{11{,}100}{5{,}750} = 1.93$
4 1	1⅛" 1⅛" 1"	$\frac{15{,}750}{5{,}750} = 2.74$
4 3	1⅛" 1⅛" 1⅛"	$\frac{15{,}750}{8{,}650} = 1.82$
6 5	1¼" 1¼" 1¼"	$\frac{21{,}650}{11{,}850} = 1.83$
8 5	1½" 1½" 1¼"	$\frac{37{,}500}{11{,}850} = 3.17$

FIG. 9—RATIOS OF STRENGTHS OF DIFFERENT SECTIONS

strength of the pin that prevents the rod from turning. If the pin is made large enough to have ample shearing strength—so that the shearing strength of the pin will equal the torsional strength of the bar—a large amount of metal must be drilled from the rod for the pinhole which will greatly decrease its torsional strength.

RESULTS FROM OPERATION IMPROVE

Central-Station Returns for First Quarter of 1915 Show Better Gains than Last Quarter of 1914

Excepting August and September, 1914, the returns received by the ELECTRICAL WORLD from central stations for March showed better percentages of increase in financial income and in output of electrical energy than in previous months of the European war period. The gain in income over March, 1914, was 6.4 per cent, and the gain in output of electrical energy was 4.8 per cent.

Table II shows that this condition of renewed prosperity was not confined to any particular locality but was general. In the New England States, it will be noticed, the normal conditions of steady growth were

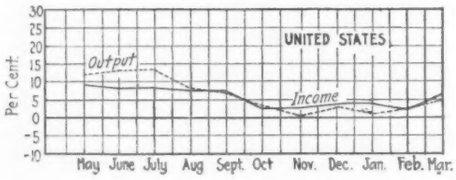


FIG. 1—CENTRAL-STATION INCOME AND OUTPUT GAIN BY MONTHS IN PER CENT FOR UNITED STATES

reached again, while the Central States attained almost the same normal conditions. The business of central-station companies generally in the Atlantic States was substantially better than Table II shows, because the returns of one large hydroelectric property affected the totals materially. This company lost a large amount of business owing to some recent legislation. If the returns from this company are omitted, as compared with March, 1914, the gains for the Atlantic States advance from 4.7 per cent to 5.2 per cent in income and from 3.3 per cent to 8.3 per cent in kilowatt-hour output. While the gains in output in the Far West are not yet improved sufficiently to be large, they are better than any others registered since last September. The figures of gain in income, however, are equal to those of normal times.

Although the companies operating in the larger metropolitan districts generally did extremely well in March in comparison with the five previous months, the returns to better business conditions had come earlier in some of the communities, and the results for March in such large cities were simply a repetition of previous months.

Reports from the smaller cities also showed generally a better tone. However, in the cities where the industries specialized in but one or two lines and were slow in recovering from the depression the inactivity was reflected in the central-station results of operation.

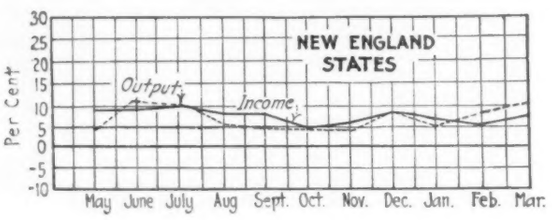
According to Table I, the gross income for the eleven months from May, 1914, to March, 1915, inclusive, was $337,900,000, in comparison with $320,050,000 for the similar period twelve months previous, or an increase of 5.7 per cent. The kilowatt-hour output in the same period was 16,690,000,000 kw-hr., as against 15,667,000,000 kw-hr., or an increase of 5.6 per cent.

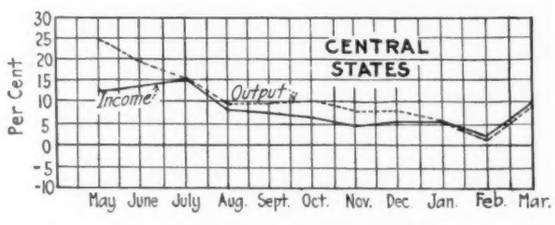
During the first quarter of 1915 the gain in income amounted to 4.2 per cent over the corresponding quarter of the previous year, as compared with a gain of 3.1 per cent in the last quarter of 1914. The gain in the output of kilowatt-hours for the first quarter of 1915 was 2.7 per cent, as compared with 2.6 per cent for the last quarter of 1914. This is further compared with the quarter immediately preceding the outbreak of the war, namely, May, June and July, 1914, when the gain in income was 8.7 per cent, and in kilowatt-hour output it was 12.7 per cent.

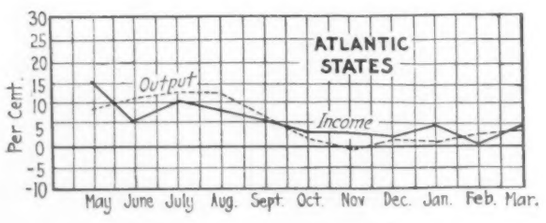
TABLE I—CENTRAL-STATION RETURNS FOR ELEVEN-MONTH PERIOD

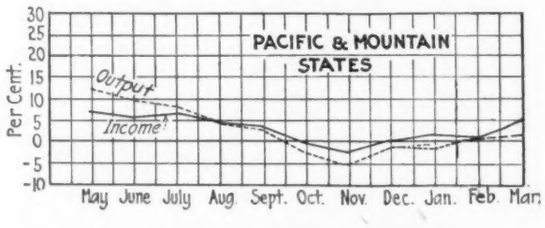
	Percentage of Industry Represented	Income from the Sale of Energy			Kw-hr. Output		
		1914	1913	Per Cent Increase	1914	1913	Per Cent Increase
1914							
May.	45	$14,295,321	$13,099,007	9.1	674,877,591	602,832,337	12.0
June.	45	14,073,840	12,996,198	8.3	682,791,096	603,122,008	13.3
July..	50	14,086,822	12,970,325	8.5	735,937,850	649,720,026	13.3
Aug..	51	15,298,226	14,200,649	7.8	778,109,565	718,274,456	8.2
Sept..	51	15,708,695	14,694,205	7.0	782,450,267	733,754,420	6.8
Oct..	59	17,667,912	17,174,567	2.8	969,817,024	935,249,519	3.0
Nov..	65	19,777,650	19,260,451	2.7	986,456,324	978,934,946	0.8
Dec..	65	20,978,430	20,281,812	3.3	1,074,083,543	1,043,457,795	3.0
1915		1915	1914		1915	1914	
Jan..	65	21,582,547	20,697,423	4.1	980,085,036	966,200,323	1.4
Feb..	63	19,395,518	19,023,107	2.0	853,817,221	835,288,039	2.2
Mar..	64	18,654,443	17,529,054	6.4	939,117,179	896,903,968	4.8

Reports from the companies in the Atlantic States say that the improvement in business arose from better demand for energy for industrial uses; the demand for domestic consumption was reduced. Letters from operators in the Middle West state that conditions in the









FIGS. 2 TO 5—CENTRAL-STATION INCOME AND OUTPUT GAIN BY MONTHS IN PER CENT SECTIONALLY

In the Far West it seems to be the consensus of opinion that the decrease in irrigation load, due to weather conditions, restricted improvement. This was offset in generating field were normal for the most part and that increases were due merely to natural growth.

some cases by a strenuous campaign for new irrigation load. The Far Northwest is still depressed owing to the state of the lumber market, but in the Pacific Coast district south of that section conditions are better. One company selling energy to a railway company reports an increase in this load due to better traffic conditions. The first is attributed to brighter conditions generally, and the latter mostly to improvements in lighting practice. In many cases the introduction of high-grade tungsten lamps for street lighting has reduced the load. Jitney competition has affected railway companies. In the mining regions, especially in zinc and copper districts, the great demand for metals on a rising market has had a pronounced effect on central-station earnings and output.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER AN ELEVEN-MONTH PERIOD

	Month	New England States			Atlantic States			Central States (Illinois Excluded)			Pacific and Mountain States		
		Percentage of Industry Represented	1914	1913	Per Cent Increase	Percentage of Industry Represented	1914	1913	Per Cent Increase	Percentage of Industry Represented	1914	1913	Per Cent Increase	Percentage of Industry Represented	1914	1913	Per Cent Increase
INCOME	May	55	$1,745,160	$1,609,234	8.4	58	$6,492,767	$5,628,718	14.5	43	$3,200,553	$2,841,685	12.7	57	$1,525,729	$1,426,885	7 0
	June	58	1,560,872	1,442,178	8.3	54	6,067,780	5,578,311	6.0	52	3,914,836	3,459,497	13.2	67	1,894,887	1,791,918	5.8
	July	60	1,670,819	1,530,410	9.2	54	6,152,169	5,583,309	10.2	52	3,802,126	3,307,719	15.0	72	2,212,827	2,068,249	6.8
	August	61	1,734,583	1,607,649	7.5	55	6,224,896	5,755,515	8.2	57	4,389,696	4,051,678	8.4	75	2,386,677	2,282,061	4.6
	Sept	61	1,766,587	1,647,945	7.3	55	6,608,221	6,221,000	6.1	57	4,704,780	4,368,251	7.9	75	2,487,513	2,398,176	3.7
	Oct	64	1,963,579	1,889,255	4.0	67	7,451,220	7,232,063	3.1	57	5,105,810	4,783,847	6.8	85	3,146,160	3,157,689	0.3*
	Nov	67	2,229,742	2,115,957	5.6	69	8,373,772	8,157,966	2.7	57	5,408,672	5,158,981	4.8	88	3,503,499	3,574,086	2.0*
	Dec	67	2,385,711	2,218,387	7.5	69	8,765,275	8,594,773	2.2	57	5,992,542	5,654,740	5.9	88	3,834,902	3,813,912	0.3
			1915	1914			1915	1914			1915	1914			1915	1914	
	Jan	67	2,423,795	2,271,881	6.8	69	9,075,335	8,695,593	4.4	57	5,827,997	5,525,570	5.4	88	3,960,608	3,917,371	1.0
	Feb	67	2,246,794	2,134,341	5.4	69	8,037,878	7,968,625	0.9	55	5,296,786	5,148,439	3.0	85	3,576,432	3,534,864	1.2
	March	67	3,146,032	1,999,326	7.5	69	7,777,126	7,419,808	4.7	55	4,885,384	4,465,728	9.5	88	3,605,893	3,412,842	5.8
KW-HR. OUTPUT	May	55	52,752,247	50,779,103	3.9	58	259,098,542	238,733,320	8.4	43	202,611,026	162,363,929	24.8	57	144,839,552	129,357,915	11.9
	June	58	53,463,013	48,049,756	11.1	54	244,936,886	221,315,464	10.8	52	217,920,183	182,406,207	19.4	67	155,326,455	141,836,377	9.6
	July	60	54,074,533	49,255,893	9.8	54	263,580,290	235,068,939	11.8	52	217,928,950	188,569,581	15.6	72	183,160,015	169,718,387	7.9
	Aug	61	55,801,224	52,913,483	5.4	55	264,717,319	237,984,895	11.2	57	267,501,400	226,276,638	9.4	75	193,216,699	185,330,705	4.2
	Sept	61	55,525,272	53,267,877	4.3	55	270,974,533	252,648,550	7.3	57	260,705,339	237,832,934	9.7	75	190,979,705	185,090,658	3.2
	Oct	64	67,520,070	65,068,938	3.8	67	358,458,539	351,362,247	2.1	57	295,490,712	266,827,567	10.5	85	245,966,868	252,047,828	2.4*
	Nov	67	69,480,163	66,988,456	3.8	69	361,364,405	364,155,759	0.7*	57	290,681,750	269,220,528	8.0	88	255,651,947	269,467,354	5.1*
	Dec	67	78,510,793	71,990,132	7.8	69	401,623,514	396,251,867	1.2	57	315,027,232	291,511,670	8 0	88	278,922,004	283,704,076	1.6*
			1915	1914			1915	1914			1915	1914			1915	1914	
	Jan	67	72,550,608	69,317,803	4.7	69	374,972,536	373,336,906	0.7	57	272,623,760	258,572,903	5.5	88	252,531,483	256,198,272	1.4*
	Feb	67	66,600,132	61,515,979	8.3	69	312,443,505	305,307,260	2.4	55	238,938,034	232,520,476	2.7	85	229,865,568	229,185,967	0.3
	March	67	72,121,319	65,343,335	10.5	69	346,341,496	335,506,429	3.3	55	257,136,231	235,656,647	9.2	88	255,529,704	253,423,951	1.9

*Decrease.

TABLE III—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT-HOUR OUTPUT FOR UNITED STATES—CITIES GROUPED ACCORDING TO SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
INCOME:							
Group 1	8.0	4.2	2.6	2.6	2.7	2.0	8.0
Group 2	8.2	4.7	4.7	4.9	8.8	3.7	6.9
Group 3	4.2	1.2	0.5	3.3	2.4	2.5	5.2
Group 4	10.0	15.1	4.8	4.8	5.8	6.8	5.0
Group 5	9.1	3.5	1.5	3.2	4.5	0.9	1.6*
OUTPUT:							
Group 1	5.5	3.2	0.5	3.1	3.9	2.8	5.7
Group 2	14.0	5.2	4.2	3.0	4.3	5.7	7.9
Group 3	2.7	4.6*	7.2*	6.8	1.2	3.9*	3.6*
Group 4	9.5	6.3	5.7	9.2	9.0	5.5	3.2
Group 5	4.0	2.9	2.6*	1.8	7.5	15.0	7.0

*Decrease.

TABLE IV—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT-HOUR OUTPUT FOR NEW ENGLAND STATES—CITIES GROUPED ACCORDING TO SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
INCOME:							
Group 1	5.8	5.0	6.1	7.9	7.1	5.7	6.6
Group 2	6.3	2.3	2.3	5.5	6.2	4.1	9.0
Group 3	7.0	6.1	9.7	11.4	7.5	0.7	7.8
Group 4	3.9	5.8	9.0	8.2	8.9	9.4	6 5
Group 5	17.8	8.0	3.9	5.5	2.1*	1.9	14.7*
OUTPUT:							
Group 1	2.0	4.2	6.9	12.5	6.3	11.1	12.0
Group 2	12.0	1.0	1.5*	5.9	5.4	6.4	12.3
Group 3	7.4*	6.6	7.5	11.0	1.2	3.6*	0.3*
Group 4	15.0	14.2	4.2	12.5	10.9*	9.4	12.5
Group 5	9.7*	8.1*	8.3*	4.1	9.0*	6.1	29.8*

*Decrease.

TABLE V—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT-HOUR OUTPUT FOR ATLANTIC STATES—CITIES GROUPED ACCORDING TO SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
INCOME:							
Group 1	7.8	6.2	3.0	1.6	1.3	1.3	4.7
Group 2	6.1	7.1	2.7	3.9	5.0	4.2	7.1
Group 3	7.9	1.4	0.3*	0.4	3.3	3.6	3.8
Group 4	8.3	6.8	4.8	7.9	4.9	10.1	6.8
Group 5	10.0	10 2	13.5	11.2	9.0	†	†
OUTPUT:							
Group 1	7.1	4.6	0.0	3.2	1.7	3.0	6.1
Group 2	15.6	10.3	5.0	4.3	3.1	7.0	9.7
Group 3	16.4	6.0*	8.5*	7.7*	7.4	2.7*	8.5*
Group 4	2 2	0.0	3.8	6.2	7.8	6.3	10.2
Group 5	26.8	46.5	57.5	11.1	13.5	†	†

*Decrease.
†Results omitted owing to insufficient returns.

TABLE VI—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT-HOUR OUTPUT FOR CENTRAL STATES—CITIES GROUPED ACCORDING TO SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb	March
INCOME:							
Group 1	7.7	7.0	4.7	5.2	6.1	3.5	10.1
Group 2	9.5	4.7	5.2	7.5	4.3	1.4	5.9
Group 3	0.0	4.0	4.0	7.5	2.1	6.2	11.3
Group 4	11.3	8.1	4.3	6.4	3.6	6.0	8.3
Group 5	9.5	1.6	0.5*	1.5*	3.7	2.8	7.7
OUTPUT:							
Group 1	5.7	6.3	2.4	4.2	9.0	4.7	7.7
Group 2	21.0	11.2	14.8	12.4	4.8	1.2	8.0
Group 3	4.4	5.0	6.6	12.4	8.2	6.2	14.7
Group 4	14.7	7.8	8.3	13.3	8.4	10.0	12.8
Group 5	21.0	5.0	4.9	13.0	13.7	18.3	13.5

*Decrease.

California expositions have proved advantageous to the companies operating in these localities.

Central-station managers throughout the country report a better industrial load and a poorer lighting load.

The accompanying curves show graphically the per-

centages of increases given in Tables I and II. Tables I and II show the gross returns received by the ELECTRICAL WORLD. Tables III to VII, inclusive, show the percentages of increases for companies grouped according to the size of the communities in which they operate. Group 1 includes cities whose population is over 100,000; group 2, cities between 50,000 and 100,000; group 3, between 25,000 and 50,000; group 4, between 10,000 and 25,000, and group 5, between 5000 and 10,000.

TABLE VII—PERCENTAGE RATE OF INCREASE IN INCOME AND KILOWATT HOUR OUTPUT FOR PACIFIC AND MOUNTAIN STATES—CITIES GROUPED ACCORDING TO SIZE

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
INCOME:							
Group 1.....	7.5	0.3*	2.4*	0.6*	1.0*	0.4	8.1
Group 2.....	13.1	2.0	1.1	1.0	4.9	8.0	7.5
Group 3.....	3.8	1.7*	3.5*	1.0	0.6	2.6*	1.0*
Group 4.....	17.7	2.9*	1.4	6.5	6.2	0.6	2.6*
Group 5.....	4.4	0.1	3.1*	2.5*	1.8	2.0*	3.5*
OUTPUT:							
Group 1.....	2.3	1.6*	2.1*	0.0	1.5	0.5*	2.5
Group 2.....	4.5*	13.0*	7.7*	13.0*	7.2*	13.5	3.0
Group 3.....	12.7	7.3*	14.1*	14.2*	13.5*	11.5*	4.0*
Group 4.....	12.0	7.1	4.4	3.7	9.5	0.6*	9.5*
Group 5.....	7.2*	1.1	2.9*	1.0	4.1	9.9	18.0

*Decrease.

The Skin Effect in Bimetallic Wires

BY JOHN M. MILLER

In a series of three papers in the ELECTRICAL WORLD of 1910 and 1911 Mr. F. F. Fowle[1] treated very thoroughly the electrical properties of compound, or bimetallic, wires carrying direct current. In particular, the second paper gave a somewhat complicated formula for the inductance which is internal to the conductor. The present paper[2] is, in a sense, an extension of Mr. Fowle's work, in that it develops a method of computing the effective resistance and inductance of bimetallic wires over a considerable range of frequencies.

The bimetallic wire is considered to be a conductor which has a circular core of one conducting material surrounded by a concentric cylindrical shell of another material. In the following the core and shell are treated as two circuits in parallel, each having resistance and self-inductance and a mutual inductance with respect to the other.

$$M_{1,2} = M_{2,1} = 1 - \frac{2r_1^2}{r_2^2 - r_1^2} \log_\epsilon \frac{r_2}{r_1} = M.$$

Neglecting the magnetic field external to the wire, the following expressions for the self-inductance of the core, the mutual inductance between the core and the shell, and the self-inductance of the shell, all in absolute units, may be derived on the assumption that the current in the core is uniformly distributed and that the current in the shell is likewise uniformly distributed:

$$L_1 = \frac{\mu}{2} + 2 \log_\epsilon \frac{r_2}{r_1}. \qquad (1)$$

$$M = 1 - 2\frac{r_1^2}{r_2^2 - r_1^2} \log_\epsilon \frac{r_2}{r_1}. \qquad (2)$$

$$L_2 = \frac{1}{2} - \left(\frac{r_1^2}{r_2^2 - r_1^2}\right)\left(1 - \frac{2r_1^2}{r_2^2 - r_1^2} \log_\epsilon \frac{r_2}{r_1}\right). \qquad (3)$$

where μ = permeability of the core, r_1 = the radius of the core in centimeters, r_2 = radius of the shell in centimeters.

In the case of an alternating current, particularly if the frequency is high, the assumption that the currents in the shell and core are uniformly distributed does not hold; i. e., the so-called "skin effect" becomes appreciable. However, when the shell is not very thick and the frequency not very high, the distribution of the current in the shell will remain practically uniform and the skin effect in the shell will be negligible. In the core, however, particularly in the case of a magnetic metal, the distribution will be considerably changed, and hence the resistance and inductance of the core will change appreciably as the frequency increases.

Both the effective inductance and resistance of the core for a given frequency, if μ = constant, may be calculated from the well-known formulas for the effective resistance and inductance of a straight cylindrical conductor. These were given by Kelvin in terms of the functions ber x and bei x and their derivatives ber′ x and bei′ x where

$$x = 2\rho\sqrt{\frac{\pi p \mu}{\sigma}}$$

and ρ = radius of conductor in cm,
σ = resistivity of the material in absolute electromagnetic units,
μ = permeability,
$p = 2\pi$ times the frequency.

The formulas for the effective resistance and inductance can be put in simple forms by the use of auxiliary quantities W, Y and Z, which in turn are functions of ber x, bei x, ber′ x and bei′ x; namely, the effective resistance R'_1 may be written

$$R'_1 = R_1\left(\frac{x}{2}\frac{W}{Y}\right), \qquad (4)$$

where R_1 is the direct-current resistance, and the internal inductance may be written

$$L'_1 = \frac{\mu}{2}\left(\frac{4}{x}\frac{Z}{Y}\right) + 2\log_\epsilon \frac{r_2}{r_1}. \qquad (5)$$

Tables of $\left(\frac{x}{2}\frac{W}{Y}\right)$ and $\left(\frac{4}{x}\frac{Z}{Y}\right)$ for different values of x have been given by Rosa and Grover.[3]

In general, the effective resistance R and the effective inductance L of any two circuits in parallel are

$$R = \frac{[R'_1R_2 - p^2(L'_1L_2 - M^2)]\ (R'_1 + R_2) + p^2(R'_1L_2 + R_2L'_1)\ (L'_1 + L_2 - 2M)}{(R'_1 + R_2)^2 + p^2(L'_1 + L_2 - 2M)^2}, \qquad (6)$$

$$L = \frac{(R'_1L_2 + R_2L'_1)\ (R'_1 + R_2) - [R'_1R_2 - p^2(L'_1L_2 - M^2)]\ (L'_1 + L_2 - 2M)}{(R'_1 + R_2)^2 + p^2(L'_1 + L_2 - 2M)^2}, \qquad (7)$$

where R'_1 and L'_1 are the effective resistance and inductance of circuit No. 1, R_2 and L_2 the effective resistance and inductance of circuit No. 2, M the mutual inductance between the two circuits, and $p = 2\pi$ times the frequency. These relations also hold for the effective resistance R and the internal inductance L of a bimetallic wire, when for L'_1 is taken the internal inductance of the core as given by equation (5), for L_2 the internal inductance of the shell as given by equation (3), for M the mutual inductance given by equation (2), for R'_1 the effective resistance of the core as given by equation (4), and for R_2 the direct-current resistance of the shell; provided that the assumption that the current in the shell is uniformly distributed is justified. To check this assumption, equations (6) and (7) were used to calculate the effective resistance and internal

[1] Fowle, ELECTRICAL WORLD, Vol. 56, page 1471, and page 1521, 1910; Vol. 57, page 108, 1911.

[2] Abstracted from a paper by the author entitled "The Effective Resistance and Inductance of Iron and Bimetallic Wires," in the Bulletin of the Bureau of Standards.

[3] "Formulas and Tables for the Calculation of Mutual and Self-Inductance" (Revised). Bulletin Bureau of Standards, Vol. 8, page 226, 1911; Scientific Paper No. 169.

inductance of a *solid* No. 4 American Wire Gage copper wire, by considering this wire as made up of a copper core and a copper shell, the diameter of the core being taken equal to that of the core of a No. 4 bimetallic wire; namely, by taking $r_1 = 0.2607$ cm, $r_2 = 0.2231$ cm, and $\sigma = 1770.6$ absolute units. These calculations, which are designated by *A* in Table No. 1, were compared with the calculations *B* made directly by the use of equations (4) and (5), which are exact relations for a solid wire.

TABLE I—DATA FOR SOLID COPPER WIRE

Cycles per Second	0	1000	3000	5000
Effective resistance (A)	0.8293	0.8667	1.0912	1.3432
Ohms per kilometer (B)	0.8293	0.8676	1.0972	1.3582
Per cent difference	0.0	0.1	0.6	1.1
Effective inductance (A)	50.00	48.86	42.20	35.30
Microhenries per kilometer (B)	50.00	48.85	42.14	35.14
Per cent difference	0.0	0.0	0.1	0.5

The errors even at 5000 cycles per second are only 1.1 per cent for the resistance and 0.5 per cent for the inductance.

The application of equations (6) and (7) to the calculation of the effective resistance and internal inductance of bimetallic wires requires, in addition to the resistivities and dimensions of the core and shell, a knowledge of the value of the permeability μ of the steel core. In addition, the assumption that the permeability is constant must also be made. For small currents, and therefore feeble magnetizing forces, the assumption that μ is constant is approximately correct, but for heavy currents μ may differ appreciably from its initial value. The initial values of the permeability of the core for Nos. 4, 8 and 10 wires were found to be 90, 85 and 70 respectively. The resistivity of the steel core of the No. 4 wire was found by measurement to be 12.6 microhm-cm. The resistivity of the hard-drawn copper was assumed to be 1.77 microhm-cm. The same values of resistivity of copper and steel were used for all three wires. Experimental determinations (made with 0.5-amp current) and computed values are compared in Table II, the resistances being given in ohms per kilometer and the internal inductances in microhenries per kilometer.

Since the values for the initial permeability and the resistivities of steel and copper may differ considerably from one wire to another, there is some uncertainty in applying the formulas to wires for which these quantities are not definitely known. Another uncertainty is caused by the deviation of the core from a circular shape, which is assumed in the calculations.

TABLE II—COMPARISON OF OBSERVED AND COMPUTED VALUES OF EFFECTIVE RESISTANCE AND INTERNAL INDUCTANCE OF COPPER-CLAD WIRES

Wire	Quantity	How Obtained	Frequency, Cycles per Second				
			0	100	500	1000	3000
No. 4	Resistance	Observed	2.24	2.29	2.60	2.73	2.94
		Computed	2.24	2.31	2.68	2.80	2.93
	Internal inductance	Observed	293	274	123	71	43
		Computed	360	316	99	46	18
No. 8	Resistance	Observed	4.42	4.43	4.58	4.77	5.04
		Computed	4.42	4.44	4.63	4.85	5.04
	Internal inductance	Observed	141	140	112	75	38
		Computed	163	160	118	71	30
No. 10	Resistance	Observed	8.15	8.16	8.36	8.72	9.38
		Computed	8.15	8.16	8.32	8.67	9.46
	Internal inductance	Observed	198	198	171	122	45
		Computed	195	194	176	137	53

The computed resistances are not affected strongly by these uncertainties, but the internal inductances may be considerably in error. This is well illustrated in the case of the No. 4 wire. The thickness of the shell of this wire varies from 0.1 mm to 1.0 mm; moreover, it was found, after the calculations were made, that the conductivity of the copper in this wire was considerably less than the assumed value. These sources of error have not affected the resistance computations appreciably but very probably explain the differences between the computed and measured inductances.

By means of the above formulas Table III has been calculated, giving the ratio (for small currents) of the effective resistance to the direct-current resistance for copper-steel bimetallic wires, Nos. 0, 2, 4, 6, 8, 10 American Wire Gage (B. & S.) for conductivities of 30, 40 and 50 per cent (of hard-drawn copper) and frequencies ranging from 50 to 3000 cycles per second. The values, while subject to the variations enumerated above, should apply to actual wires to within a few per cent.

TABLE III—RATIO OF EFFECTIVE RESISTANCE TO DIRECT-CURRENT RESISTANCE FOR COPPER-STEEL BIMETALLIC WIRES FOR SMALL CURRENTS

Wire, A. W. G.	Conductivity, per Cent	Frequency, Cycles per Second				
		50	100	500	1000	3000
No. 0	30	1.07	1.18	1.40	1.46	....
	40	1.04	1.10	1.22	1.26	....
	50	1.02	1.06	1.14	1.16	....
No. 2	30	1.03	1.10	1.35	1.42	....
	40	1.02	1.05	1.20	1.24	....
	50	1.01	1.03	1.12	1.14	....
No. 4	30	....	1.05	1.29	1.38	1.48
	40	....	1.03	1.17	1.21	1.26
	50	....	1.01	1.10	1.13	1.16
No. 6	30	....	1.02	1.21	1.32	1.43
	40	....	1.01	1.12	1.18	1.24
	50	....	1.005	1.07	1.11	1.15
No. 8	30	....	....	1.12	1.25	1.39
	40	....	....	1.07	1.14	1.22
	50	....	....	1.04	1.08	1.13
No. 10	30	....	....	1.04	1.13	1.31
	40	....	....	1.02	1.07	1.18
	50	....	....	1.01	1.04	1.11
No. 12	30	....	....	1.02	1.07	1.24
	40	....	....	1.01	1.04	1.14
	50	....	....	1.005	1.02	1.08

It is of interest to note that formula (7) for the inductance of a bimetallic wire reduces to the formula given by Fowle for the direct-current inductance, when p is put equal to zero, which is the condition for zero frequency or direct current. For direct current the currents in the core and shell are inversely as their resistances, namely,

$$\frac{R_1}{R_1 + R_2} = I_2 \text{ and } \frac{R_2}{R_1 + R_2} = I_1,$$

where I_1 and I_2 are the *proportions* of the total current in the core and shell respectively. When these substitutions are made and p is put equal to zero, equation (7) becomes

$$L_0 = L_1 I_1 + L_2 I_2 - (L_1 + L_2 - 2M) I_1 I_2.$$

Substituting herein for L_1, L_2 and M their values from equation (1), (2) and (3) gives

$$L_0 = \frac{\mu}{2} I_1^2 + 2 I_1 I_2 + \frac{1}{2} I_2^2 \left(1 - \frac{2 r_1^2}{r_2^2 - r_1^2}\right) + 2 \left(I_1 - I_2 \frac{r_1^2}{r_2^2 - r_1^2}\right)^2 \log_e \frac{r_2}{r_1},$$

which is Fowle's formula.

DIGEST OF ELECTRICAL LITERATURE

Generators, Motors and Transformers

Amortisseurs.—KARL SCHMIDT.—A brief illustrated article pointing out that in modern practice it has been found that the use of amortisseurs or damping devices in large machines may cause considerable losses which can produce an undesirable increase in the temperature of the pole shoes. It is, therefore, necessary for the damping device not to be constructed in "any old way" as heretofore. The author explains why damping devices are used and how they should be constructed in order to reduce the losses.—*Elek. Zeit.*, April 22.

Inherent Regulation of Alternators.—ALFRED STILL.—A mathematical paper, illustrated by diagrams on the inherent regulation of synchronous alternating-current generators, the method of its determination and the different factors which affect the accuracy of measurement.—*Journal Inst. Elec. Eng.* (London), April 15, 1915.

Lamps and Lighting

Efficiencies of Present-Day Illuminants.—HERBERT E. IVES.—The author defines luminous flux as "radiant power evaluated according to its capacity to produce the sensation of light." If the luminous output is measured in watts (1 lumen = 0.00162 watt), the ratio of the luminous output in watts to the power input in watts is called the total luminous efficiency. By multiplying the figures in any table giving lumens per watt by 0.00162, a table of total luminous efficiency is obtained. The carbon lamp, consuming 4 watts per mean horizontal cp, gives 2.6 lumens per watt and has a total luminous efficiency of 0.42 per cent. The vacuum tungsten lamp consuming 1.25 watts per horizontal cp gives 8 lumens per watt; efficiency, 0.013 (or 1.3 per cent). Gas-filled tungsten lamps (600 cp, 20 amp, 0.5 watt per cp) give 19.6 lumens per watt; efficiency, 3.2 per cent. The 6.6-amp direct-current magnetite arc gives 21.6 lumens per watt; efficiency, 3.5 per cent. The inclosed white-flame carbon arc (6.5 amp, direct current) gives 35.5 lumens per watt; efficiency, 5.8 per cent. The quartz mercury arc (174 volts to 197 volts, 4.2 amp) gives 42 lumens per watt; efficiency, 6.8 per cent. The 10-amp direct-current yellow-flame open arc gives 44.7 lumens per watt; efficiency, 7.2 per cent. Other total efficiencies are as follows: Moore nitrogen vacuum tube, 0.85 per cent; acetylene lamp, 0.11 per cent; petroleum lamp, 0.04 per cent; low-pressure incandescent gas lamp, 0.19 per cent; high-pressure incandescent gas lamp, 3.2 per cent; open-flame gas burner, 0.036 per cent. All these figures are total luminous efficiencies. The highest efficiencies tabulated are those of the mercury arc in quartz and the yellow-flame arc. In both cases, however, the over-all efficiency is much reduced by the steadying resistances indispensable for practical operation. The author adds a few notes on "radiation efficiency," defined as the fraction of the applied power which is transformed into radiation. In the case of the carbon vacuum incandescent lamp the radiation efficiency is $0.0042 \div 0.0045$, or over 90 per cent, while in the case of the incandescent gas burner this ratio is $0.0019 \div 0.012 = 0.16$; in other words, five-sixths of the applied power is lost as convection and conduction.—*Phys. Review*, May, 1915.

Traction

Driving Submarines.—NORMAN H. WOOD.—An illustrated article on main-motor-starting switchgear used on modern German submarines. On the surface a submarine is propelled by means of internal-combustion engines using crude oil, but when diving and running submerged the boat is driven by powerful electric motors and maintained at the desired depth by means of diving rudders or hydroplanes. Should, however, the main motors or their starting switchgear break down when the boat is running submerged, the diving action of the hydroplanes becomes nil, and the submarine, owing to its reserve buoyancy, will immediately rise to the surface, thereby becoming a helpless target for the guns or ram of an enemy warship having a greater surface speed than itself. These motors receive their current from a large storage battery usually placed amidships, and on modern German submarines the starting gear is of a very special type, the peculiarity being that the starting rheostat has been entirely eliminated. The electrical arrangement is described in some detail.—London *Elec. Review*, May 28, 1915.

Wires, Wiring and Conduits

Zinc Cables Insulated with Reclaimed Rubber.—A brief note stating that a notice has been issued in Germany that the iron wires and cables insulated with india-rubber which have been put on the market in that country on account of the shortness of copper are contrary to the new emergency standards and are no longer to be employed. Paper insulation under a metal covering is allowed with iron wires, but rubber-insulated wires must be of zinc, and for the rubber insulation only reclaimed rubber may be employed. The reason given is that, owing to the mechanical weakness of the reclaimed rubber, it would be liable to break in handling if it were employed on stiff iron conductors. New standards have been issued for the zinc conductors which are to be used as a substitute for copper. The sizes of the zinc cables range from 1.5 sq. mm (equivalent to about No. 17 standard wire gage zinc wire or 22 s. w. g. copper) to 150 sq. mm (equivalent to about 37/13 s. w. g. zinc or between 19/15 and 19/16 s. w. g. copper), and the radial thickness of this inferior rubber is to be 1 mm (0.039 in.) on the smallest size, increasing to 2 mm (0.079 in.) on the largest size—"that is to say, in the case of the bigger cables even less than the standard of the British Engineering Standards Committee for good rubber." Apparently seven-strand wire is to be used even for the smallest size, and nineteen-strand and thirty-seven-strand for the larger sizes.—London *Elec. Eng'ing*, May 27, 1915.

Electrophysics and Magnetism

Metallic Conduction and High Temperatures.—E. F. NORTHRUP.—An illustrated paper on high-temperature investigation and the study of metallic conduction. From the work so far done the metallic elements may be grouped in respect to their property of electrical conduction as follows: (1) Elements which either melt at so high a temperature or enter so readily at high temperature into chemical combinations with any surrounding substance that their resistivity curves have not been traced over a temperature range in which they pass through a change of state. To this group belong such metals as iron, nickel, cobalt, tungsten, molybdenum, tantalum, platinum, iridium, rhodium, etc. (2) Elements which upon becoming molten about double in resistance as they pass from the complete solid to the completely liquid state and thereafter increase in resistance with rise in temperature in a strictly linear way to near their vaporization temperature or to the highest temperature at which they have been examined. To this group belong aluminum, copper, tin, gold, silver and lead. (3) Elements which upon liquefying suddenly increase in resistance and thereafter possess

a positive temperature-resistance coefficient which is only approximately constant. To this group belong mercury, sodium and potassium. (4) Elements which upon liquefying suddenly increase in resistance, about doubling, and thereafter possess over a considerable range of temperature a negative coefficient which gradually changes to positive before vaporization is reached. Zinc and cadmium are the only known representatives of this group. (5) Elements which upon liquefying more or less suddenly decrease in resistance and thereafter steadily increase. Antimony and bismuth are the only known representatives in this group. Some prominent facts of metallic conduction over a wide range of temperature are listed as follows: (a) All metallic elements exhibit at ordinary temperature a conductivity which is about a million times as great as the conductivity of electrolytes. (b) The general tendency of pure metals, but not of alloys, is to reach zero resistance at zero degree Kelvin (absolute zero) and to increase steadily in resistance with rise in temperature, except when the metal passes through a change of state or when from any cause the molecular aggregation changes (as when nickel or iron loses its magnetism from increase in temperature). (c) When a change of state occurs this change is, without exception, accompanied by a change in resistance, which is more or less sudden. If the change in state occurs very abruptly, the change in resistance is also abrupt, as shown in the case of bismuth. If the change of state is somewhat gradual, the change in resistance is less abrupt, as is shown when aluminum melts. (d) The general tendency is for the resistance to become linear when the metal becomes molten. So far as studied, this seems to be the tendency also with alloys. (e) The increase in resistance when the metal is molten is never so rapid that the curve when projected toward lower temperature ever cuts the temperature axis near zero deg. K, but always far below it. (f) An increase in metallic resistance is always accompanied by a decrease in density, and when, as happens in the case of antimony and bismuth, the density increases the resistance decreases. (g) The ratio, coefficient of resistance of molten metals which change linearly in the molten state to the coefficient of volume expansion in the molten state, is quite approximately the same for those metals which have been examined in this particular. (h) When the metals crystallize, when they are powdered, and probably when the powders of different metals are mixed together, and when metals are alloyed together, the resistivity is always increased. The author then discusses the theory of metallic conduction.—*Journal Franklin Institute*, June, 1915.

Units, Measurements and Instruments

Dimensions of Electric Units.—H. MAURER.—Electric and magnetic units have different dimensions in the electromagnetic system and in the electrostatic system. This is explained by the fact that in Coulomb's law the factor of proportionality is assumed to be a pure number without dimensions. This assumption is considered to be an error. If that factor of proportionality is given the dimensions of the square of a velocity, there will be complete agreement between the dimensions in the electromagnetic and the electrostatic systems.—*Elek. Zeit.*, May 13, 1915.

Electroscope.—An illustrated description of a new type of electroscope designed by J. A. Fleming. As shown in Fig. 1, a slip of brass about 0.25 in. wide and 2 in. long is fixed vertically on the top of a corrugated ebonite or sulphur pillar. The top of this metal slip is slightly bent over. A rectangle made of fine aluminum wire of nearly the same width and length as the slip of metal is attached by two very short cocoon silk fibers to the top of the rectangle, and these fibers are wetted with a solution of chloride of calcium to make them conduct. When the system is not charged the rectangle hangs vertically in contact with the metal slip. If a charge is given to it, the rectangle stands out at an angle. It is essential that all edges of the metal shall be carefully rounded so as to leave no sharp

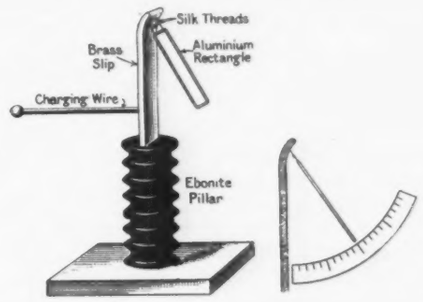


FIG. 1—THE FLEMING ELECTROSCOPE

points. To the back of the metal slip may be attached a thin wire ending in a small ball, which is convenient for making contact with electrified objects. For lecture purposes the image of the electroscope can be projected on the screen by placing it in a parallel beam of light and employing a projecting lens and an erecting prism. Fleming employs as a screen a large sheet of paper on which is drawn a curved arc divided into degrees. The radius of this arc is adjusted to be the same as the length of the image of the aluminum rectangle, so that the end of that image moves over the arc. (See diagram at the right of Fig. 1.) Such an electroscope will bear electrification to from 10,000 volts to 20,000 volts and is very convenient for exhibiting certain experiments in lectures. This electroscope is used by Fleming for demonstrating photo-electric phenomena.—London *Electrician*, May 28, 1915.

Thermal Emf of Iron Oxide and Copper Oxide.—S. LEROY BROWN AND L. O. SHUDDEMAGEN.—The oxides used in these experiments were of solid form and were

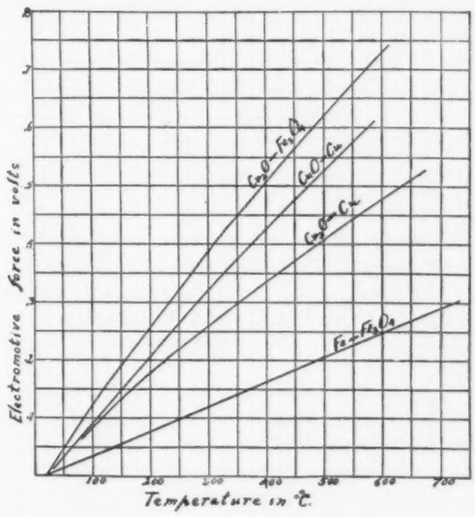


FIG. 2—THERMOS EMF CURVES

prepared either by complete oxidation of metallic wires or by melting the oxide and molding into a solid rod. Solid rods of large cross-section were obtained by melting the powdered or finely divided oxides in porcelain tubes, which were placed in a tubular electric furnace. The three oxides which were used as thermocouple elements were cupric oxide (CuO), cuprous oxide (Cu_2O),

and magnetite (Fe_3O_4). The author gives in diagrams and tables the results for the thermal electromotive forces for copper-cupric oxide, copper-cuprous oxide, iron-magnetite, iron-cuprous oxide, copper-magnetite and cuprous oxide-magnetite thermocouples with temperatures of the hot junction ranging as high as 750 deg. C. The data shows no appreciable difference between the copper-cuprous and oxide iron-cuprous oxide couples, or between iron-magnetite and copper-magnetite couples. The principal curves are given in Fig. 2. After several reheatings of a junction which has a cupric oxide element, its electromotive force will diminish and its electromotive-force curve will approach the curve that is obtained when the cupric oxide element is replaced by cuprous oxide. That is, the higher temperature partially reduces the cupric oxide to cuprous oxide. When cuprous oxide is one of the elements of a couple, the junction cannot be subjected to temperatures higher than about 800 deg. C. without decomposition, and this decomposition is accompanied by a decided decrease of thermal electromotive force.—*Phys. Review*, May, 1915.

Measuring the Distortion of Rotating Axles.—V. Vieweg and A. Wetthauer.—The authors describe a method for measuring the distortion of rotating axles by means of two rectangular prisms. The method may be used for a torsion dynamometer and for measuring phase displacement and oscillations of alternators operating in parallel.—*Zeit. f. Instrumentenkunde*, Vol. 34, page 137, 1914.

Gyroscopic Compass.—F. M. Denton.—An article giving some notes on the construction and the fundamental principles of operation of the gyroscopic compass.—London *Electrician*, May 14, 1915.

Telegraphy, Telephony and Signals

Cable Telegraphy.—H. W. Malcolm.—A continuation of his long illustrated mathematical serial on the future progress of cable telegraphy. In the present instalment the author discusses the combination of condensers with loaded cables and other combinations of loaded meshes and condensers.—London *Electrician*, May 14, 1915.

Telephone Relay.—R. Lindemann and E. Hupka.—An account of an investigation carried out in the German Reichsanstalt on the theory of the action of the Lieben telephone relay. On the basis of the ionic hypothesis the general theory of the discharge in the Lieben tube is developed. This theory permits one to predict correctly the behavior of the tube with direct current and alternating current, and especially the distortion of the wave-form with strong currents. The author describes tests with direct current, with alternating current at fifty cycles, and with high-frequency oscillations, which confirm the theoretical considerations. On account of the distortion of wave-form the tube should be used only cautiously in quantitative measurements as a current multiplier, but in telephone engineering it should be very useful.—*Archiv. f. Elek.*, Vol. 3, No. 2, 1914.

Differential Telephone Receiver.—F. W. Jordan.—Among "some novel laboratory experiments" described in a paper before the British Physical Society the following is mentioned. An ordinary receiver is connected to the secondary of a simple differentially wound transformer, and it is thus converted into a differential receiver for the purpose of electrical measurements.—London *Electrician*, May 28, 1915.

Measuring the Strength of Wireless Signals.—E. W. Marchant.—A mathematical paper read before the Wireless Society in London. The author discusses the question of direct versus indirect methods of measuring, the method of measurement by coupled secondary circuit, and different types of conductors. The article is to be concluded.—London *Electrician*, May 28, 1915.

Book Reviews

Travaux du Laboratoire Central d'Electricité. Paris: Gauthier-Villars. 424 pages, 55 illus., 26 plates.

This is the third volume containing the results of the researches at the central electrical laboratory at Paris, and covers the work for the years 1912 and 1913. The subjects discussed are as follows: The physiological effects of electric currents; the danger of shock due to capacity in alternating-current circuits; dielectric tests under unidirectional and alternating voltages; influence of frequency on dielectric strength; researches relating to magnetic measurements; radiotelegraphic wave-lengths; tests of dielectric strength on insulated wires in electric lighting; tests of new vapor lamps; photometry of different types of light sources; tests on insulating sheets. The leading characteristic of the publication is its abundant experimental quality. That is to say, the work is typically experimental in character, as distinguished from being either mathematical, deductive or didactic. Ample experimental material is offered and recorded. In particular, a large number of graphs for respiration, cardiac action and current application accompany the paper on physiological effects of electric currents.

Telegraph Engineering. By Erich Hausmann. New York: D. Van Nostrand Company. 406 pages, 192 illus. Price, $3.

This book, by Professor Hausmann, of the Brooklyn Polytechnic Institute, may be used either as a text in the engineering study of wire and cable telegraphy or as a general reference work on those branches of electrical transmission of intelligence. The first four chapters, covering simplex, duplex, quadruplex, automatic and printing telegraphy, are mainly descriptive of typical instruments and circuits, though simple theory is introduced. Successive chapters cover office equipment and traffic methods, writing and distributor-multiplex systems, police and fire-alarm signals, and railway signals. The construction and design of cables and aerial lines is considered in detail. Chapter X, on the theory of current propagation in lines, although quite complete, has been made unexpectedly concise, through clear presentation and with the aid of hyperbolic mathematical shorthand. The closing chapter is devoted to cable telegraphy and illustrates the modifications imposed upon wire-line working by the large capacity and small leakance of cables. This book carries along side by side both the practical and the theoretical studies of telegraphy, and is well worth attention from either viewpoint alone. Whether the reader wishes an explanatory review of apparatus and systems in common use or a mathematical presentation of the accepted laws of transmission line and instrument design, he will find it here. A knowledge of algebra is essential for the study of the theoretical parts, and familiarity with calculus is desirable, though the descriptive chapters and the portions on traffic should make the volume interesting and valuable to all telegraph workers.

Books Received

Financing an Enterprise. A Manual of Information and Suggestion for Promoters, Investors and Business Men Generally. By Francis Cooper. New York: The Ronald Press. 524 pages. Price, $3.

Experiences in Efficiency. By Benj. A. Franklin. New York: The Engineering Magazine Company. 168 pages. Price, $1.

POWER AND OPERATING SECTION

Giving the Man Lower Down an Opportunity

THE value of the labor of any man in any field is not entirely dependent upon his knowledge of that field and his experience in it, but as well upon his knowledge and experience in allied work. In every power plant there are ambitious men who could make remarkable progress in their work if the facilities for obtaining additional knowledge and experience in their own and allied fields were made available. The example of one power plant which granted one of its night troublemen permission to spend his morning hours in the plant's laboratory without recompense, in order to obtain such knowledge and experience as he thought would increase his value to himself and to his employer, is one that should meet with universal adoption. In fact, such opportunities for self-improvement should not only be granted upon request, but should be promoted and urged upon employees in every possible way. Employees, on the other hand, should seek such opportunities for self-improvement and make every effort to obtain permission to use all possible means to increase their value not only to themselves but also to their employers.

Translating Coal Into Dollars and Cents

THE judging of values is fundamentally a matter of comparison with some unit or fixed standard, and the more accurately that unit or standard is grasped by the mind, the more easily can values be expressed in terms of it. The necessity of thinking in terms of inches, feet, pounds and the like has fixed the magnitudes of these units so thoroughly in the minds of engineers that the mere statement of the dimensions of an object, or its weight in pounds, is sufficient to produce a clear conception of its size or heaviness. On the contrary, the expression of a value in units that are unfamiliar or that are not used frequently conveys little or no idea as to the magnitude of that value. It is the custom to state boiler and engine efficiencies in percentages, and they form an excellent basis for the comparison of performances; but it must be acknowledged that the average person does not think in percentages. He understands what is meant, no doubt, but the matter does not come home to him with the force that might be obtained by changing the basis of the comparison. Now, if any one system of expressing values can be said to be more thoroughly comprehended than any other, it is the system of money values, because of its universal appeal. Tell your fireman that, under his present methods of boiler management, the efficiency of the boiler plant is 55 per cent, whereas it ought to be from 15 to 20 per cent higher, and he will probably understand that you are dissatisfied with him; or, if your statement goes no farther, it may be a waste of breath. But tell him that out of every dollar's worth of coal he throws into the furnace he gets only 55 cents' worth of steam at the boiler nozzle, and he will entertain a vastly increased respect for the coal pile. Point out to him that, of the 45 cents from which you get no return, 15 to 20 cents could be saved by his keeping the boiler surfaces clean, stopping up leaks, and properly managing his firing, and you have impressed him with a new sense of his importance as a factor in the economy of the plant.

Changing Conditions Call for Economizers

MANY operating engineers in this country have in the past expressed the belief that the benefit derived from economizers as heat utilizers is not sufficient to warrant the expense of installation. This opinion is in many cases well founded because operating conditions do not always permit the use of economizers under the most satisfactory circumstances. Operating practice is, however, changing in favor of economizers, a development recognized by the N. E. L. A. committee on prime movers in its last report. Motors are being used quite extensively for driving auxiliaries, thereby reducing the amount of exhaust steam available for feed-water heating. Under these conditions there is the necessity of by-passing live steam from the prime movers for heating feed water or installing economizers which will utilize the heat of the furnace gases. Another change in favor of economizers has been the improvement in condensing apparatus, producing lower vacuum and consequently lower hot-well temperatures. The cost of fuel is also slowly but surely rising and contributing its part in making heat-utilizing equipment valuable. On the other hand, higher steam pressures are being used—this is one thing that limits the use of cast economizers—but the material used in constructing them can be changed, as is being done, or devices can be installed between the economizers and the boilers so that full pressure is not exerted on the former. Good performance is being obtained from recently made economizer installations, since the units are being designed so that the water circuit crosses the furnace gases several times and maximum heat transfer is assured by contracting the cross-section of the gas passage in proportion to the temperature drop through the economizer. Excessive air leakage in economizer settings is being reduced by improvements in construction and draft precautions that will hold the leakage to 2 lb. of air per pound of fuel, which seems to be a practical figure for large installations.

Plant Records That Record and Encourage

Improved economy of plant operation is the common goal of conscientious station operators and the ideal of those responsible for the money they spend, yet seemingly about as many methods and schemes are being tried in reaching this goal as there are plants in operation. Although the sure ways have frequently been outlined, yet many operators are still looking for some secret formula or undiscovered short cut to present practice, with results for the most part discouraging. Undoubtedly, there are secrets to be revealed and short cuts to be discovered in plant operation, but the way in which they are to be brought to light must have as its basis an intelligent analysis of operating conditions.

No person now questions the desirability and necessity of a cost-accounting and bookkeeping department for a manufacturing or commercial enterprise, yet it is only comparatively recently that systems of bookkeeping and cost accounting designed especially for the power plant have been given the place they deserve alongside other systems for a business that spends an equal or even less amount for its operation and maintenance. There is no "best system" of keeping plant records, for each case represents a separate and distinct problem. There are, however, at least two essential features that should be common to all. The data secured should be accurate and thoroughly representative of average conditions, and the recording of the data should be in such form that all charges and their variations for each item of operating costs are plainly shown and easily available for comparison and study.

As an example of one such system, we refer to the forms and records described in this issue and used in a steam plant where improvement not only of plant efficiency but also of man efficiency seems to be the keynote. The nature of these forms, what they aim to show and how they show it, are points for profitable study by plant men in both large and small stations. The methods of securing and discussing the data called for by these records should certainly encourage and interest men in the work.

Simply because a station is small and does not have or cannot afford the latest instruments to indicate, measure or weigh is no excuse for a lack of data covering coal, water, oil, waste, general supply and repair costs. While autographic recording and integrating devices are most useful as time and labor savers and should be procured in every possible case, a fair approximation of the results they make possible can be secured with a standard gage, an engine indicator, a speed indicator, a fuel calorimeter, water meters, platform scales, a set of calibrated tanks, and plenty of determination and ingenuity.

The main point to be remembered in compiling operating data is that elaborate and complicated records are of little value unless they show demands and conditions over short periods, for losses cannot be studied or reduced unless averages of all conditions are known. The oftener the readings are taken the smaller the chance for abnormal conditions to escape notice and for errors to creep into the data. At least hourly readings of variable factors are essential to a careful study of conditions, but when this is impossible in a small plant sufficient data on daily conditions to show weekly costs for comparison from time to time are a great help in discovering leaks and an encouragement to operators, for they can then know at all times when their record is better than that of a preceding month or year.

Selection of Lubricating Oils for Engines

There is no difficulty whatever in finding directions as to the methods of testing lubricating oils to be used in steam-engine service. Books and technical journals give instructions, more or less elaborate, for finding the density, viscosity, flash point, firing point, and so on. But the real difficulty arises in attempting to make the various tests and in applying the results obtained from them. Most of the standard tests of lubricating oils require apparatus that is not available to the average engineer, and if available he probably would have difficulty in using it correctly and accurately.

The alternatives are to have the oils tested in laboratories by men specially trained to do such work, or to make the tests less elaborate, using only such devices as may readily be obtained. The commercial testing of oil by a chemist is expensive, and unless the plant is large and the oil bill is correspondingly great, the expense of testing would not be warranted. On the other hand, if the plant is small, the tests may be made very simply. The viscosity can be judged, by comparison, by noting the time required for drops of different oils to run down an inclined glass plate; the relative densities may be determined by weighing equal volumes of the oils; the acidity may be tested by the use of litmus paper; the gumming test may be made by allowing samples to evaporate slowly, and so on for the other qualities that are to be found.

There can be no doubt that in the selling of oil to power plants much chicanery has been practised. The general lack of knowledge of the characteristics of oils on the part of engineers and their inability to make satisfactory tests encouraged the substitution of cheap grades without a corresponding reduction in price. An oil salesman is responsible for the assertion that, with five or six stock oils at hand, it is possible to make up a lubricating oil for any kind of service; and, furthermore, that it is possible to produce mainly from the cheaper stocks an oil to fulfill all the requirements that might be specified for a high-class oil on the basis of the simple tests just outlined. Manifestly, therefore, the small plant is in a position to be imposed upon, whereas the large plant can get what it pays for by having complete tests made. However, there is one way in which the small plant can reasonably expect to obtain fair treatment. The first step is to deal with a firm whose reputation for fair dealing is known. The next is to test the oils by actual use in the engine bearings or cylinders, and when a satisfactory oil has been found, to stick to that brand.

Engineering Features of Cleveland Station

Large Boilers—High Steam Pressures—Use of Both Forced and Induced Draft—Motor-Driven Auxiliaries

ENTIRELY aside from the conditions under which it is owned and operated by the sixth municipality among American cities, the recently completed Cleveland (Ohio) public lighting plant presents a number of engineering and design features which are of unusual interest to steam-plant operating engineers.

For example, motor-driven auxiliaries have been employed throughout the station, the motors for these machines being supplied with energy, according to the design of the plant, from a separate auxiliary steam turbine. This turbine exhausts into a jet condenser, the cooling water of which passes first through the economizers and thence to the boilers as feed water. The boiler units themselves are also especially interesting since they present a conservative example of the present trend toward very large boiler outputs. Although the great steam-making units in the Cleveland plant have a nominal rating of 1000 hp each, they can be operated at a steaming output equivalent to three times this nominal figure. The boilers generate steam at a pressure of 275 lb. per sq. in., with superheat amounting to nearly 150 deg. Fahr. The furnaces are equipped with both forced and induced draft, with the result that the combustion chambers can be kept at all times under practically atmospheric pressure, thus minimizing leakage losses through the settings.

One of the first novelties of construction which strike the attention of the visitor to the station is the gravity-telpher scheme by which the coal is handled from the overhead bunkers to the furnace hoppers. As the plant occupies a position at the water's edge below the 60-ft. bluff which here skirts Lake Erie, railroad

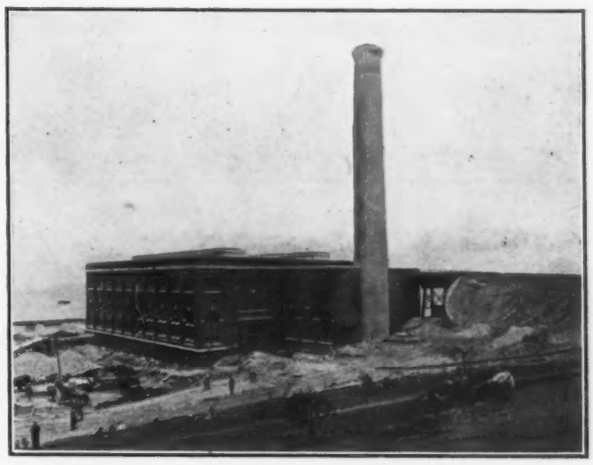


FIG. 2—RAILROAD COAL CARS CAN DISCHARGE DIRECTLY INTO THE OVERHEAD BUNKERS

coal cars are run out from the nearby Lake Shore & Michigan Southern tracks onto a trestle which is carried over the roof of the plant bunkers. From drop-bottom

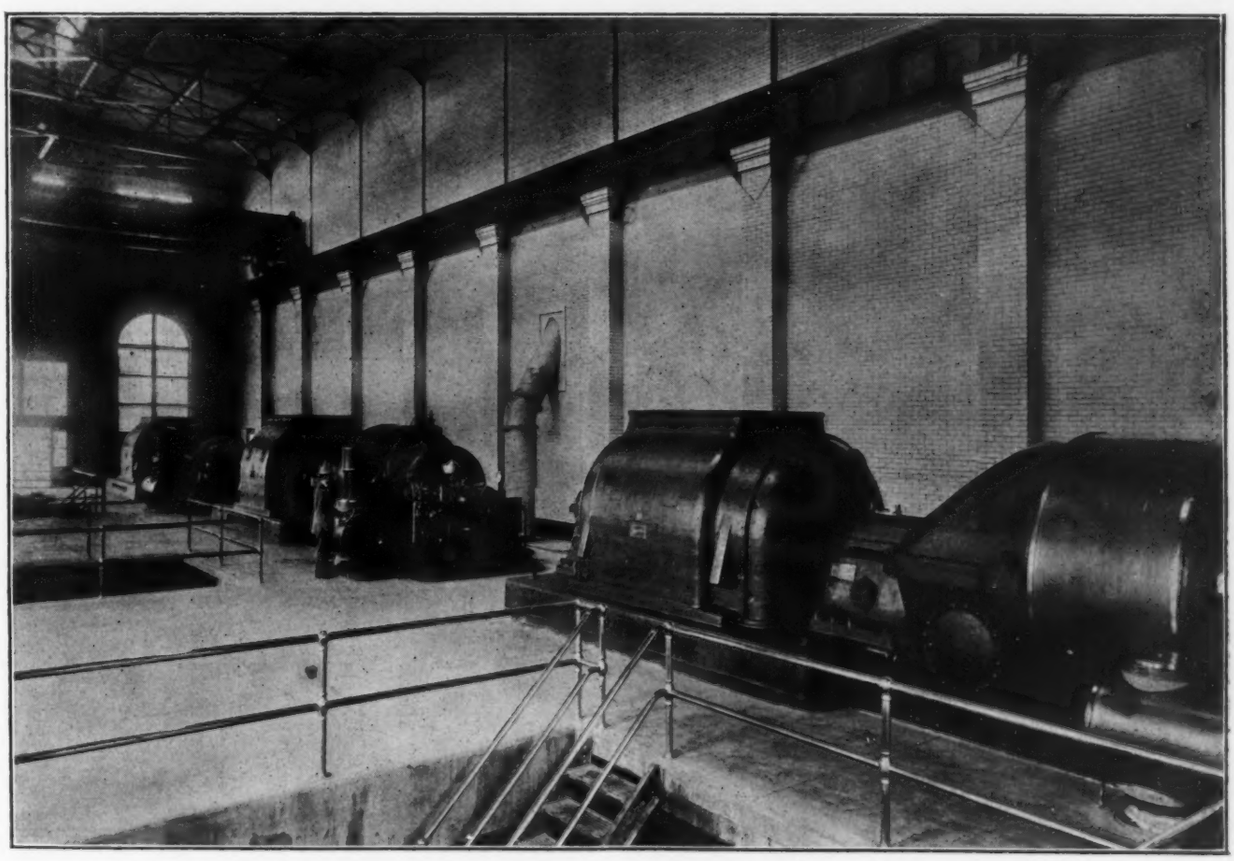


FIG. 1—THE THREE 5000-KW TURBINE ALTERNATORS IN CLEVELAND MUNICIPAL PLANT

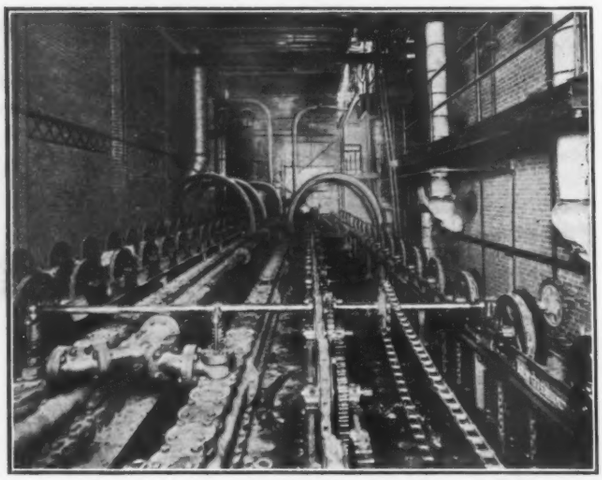


FIG. 3—A VIEW OVER THE ECONOMIZERS

cars the fuel is discharged through hatches directly into the bunkers, which have a total storage capacity of 3500 tons.

Electrically operated "Brownhoist" telpher cars, which traverse overhead monorails carried on the steel framework of the boiler room, are run under the bunker spouts, from which they receive their loads of fuel. Each telpher car carries 2 tons of coal. The bunker spouts are closed by compressed-air valves, which are easily manipulated by the telpher-car operator. Having loaded his car, the telpher operator backs it from

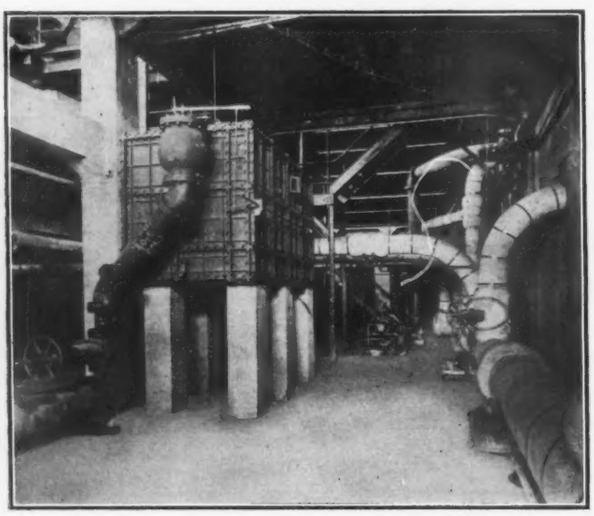


FIG. 4—MAIN STEAM HEADER IN BASEMENT

its position on the lateral monorail on which it has been standing while taking on fuel, onto the central movable bridge, which, like an engine-room crane, runs throughout the length of the boiler room on overhead rails at right angles to the lateral telpher rails. This motor-driven bridge is also under the control of the telpher operator from his position on the telpher-car platform, and the entire equipment is so arranged with interlocks that the bridge cannot be started until the telpher is completely on it and in place. On the other hand, the telpher cannot be so operated as to run off one of the open laterals unless the transfer bridge is there to receive it.

Upon reaching the aisle between the boilers which are to be fired at that trip, the transfer bridge is stopped, automatically locked in place, and the telpher run off onto one of the boiler-aisle laterals which extend over the stoker hoppers. Each furnace hopper holds about 5 tons, so that one of these hoppers need be replenished only at intervals. The coal hopper on the telpher car is carried on scale beams, and the weight of each load and the time of its delivery are carefully recorded and subsequently entered upon the log of station fuel consumption.

Each of the five Sterling boilers now installed is rated at 1000 hp, but in ordinary service can be operated at at least three times this rating. The boilers generate steam at a pressure of 275 lb. per sq. in., with a superheat of 125 deg. to 150 deg. Fahr. Each boiler has a heating surface of 10,000 sq. ft., made up of 668 tubes

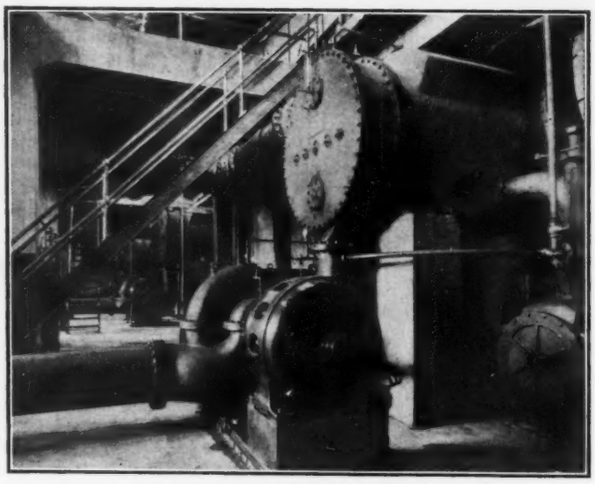


FIG. 5—THE CONDENSER CIRCULATING WATER IS BORROWED FROM THE CITY WATER SUPPLY

each 19 ft. long by 3¼ in. in diameter. The boilers are equipped with Taylor underfeed stokers, the speed of operation of which, together with that of the forced-draft fans, is controlled by variations in the steam pressure.

On their way to the 150-ft. concrete stack which has an interior diameter of 13 ft., the flue gases pass through a Green fuel economizer which has a total heat transfer surface of 27,000 sq. ft. The economizers are arranged in two parallel sections so that either half may be utilized while the other is out of service. A system of controlling dampers also makes it possible

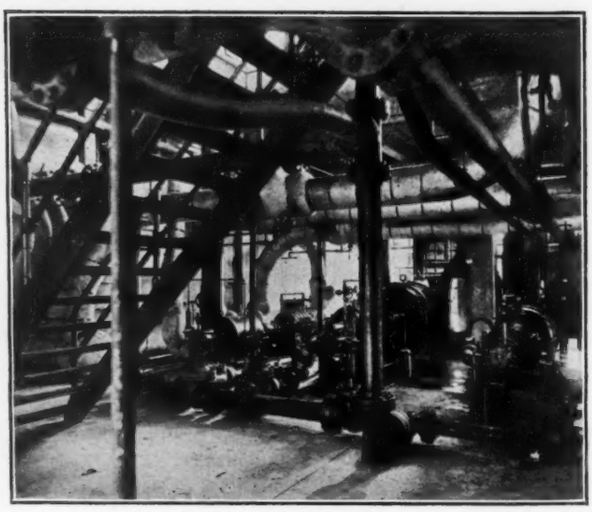


FIG. 6—MOTOR-DRIVEN AUXILIARIES AND TURBINE PUMPS

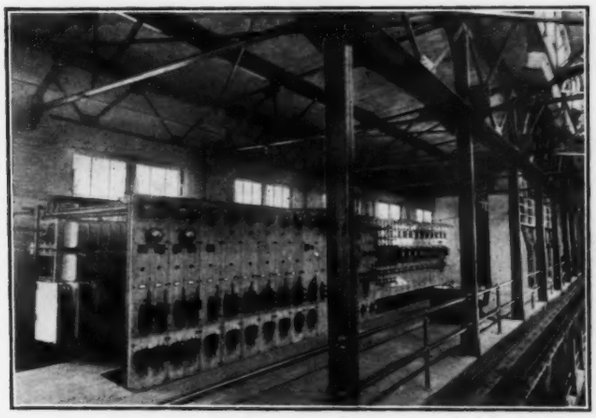


FIG. 7—SWITCHBOARD OVERLOOKING OPERATING FLOOR

to use the motor-driven induced-draft fans with or without the economizers, or the economizers with or without induced draft. The huge breeching measures 8 ft. by 15 ft.

By this provision of both forced and induced draft it is possible to carry practically atmospheric pressure in the combustion chambers, thus avoiding leakage of air through the boiler settings, which would diminish operating efficiency. The induced-draft fans are in duplicate, and either is of sufficient size to operate the

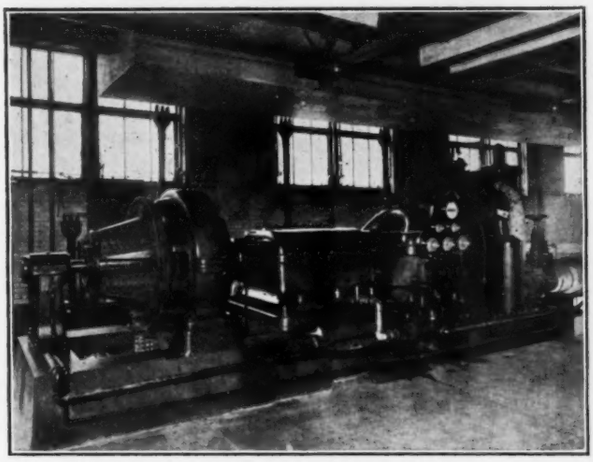


FIG. 8—TURBINE GEAR-CONNECTED TO EXCITER

station during peak load. The 200-hp motors which drive these 15-ft. fans are under manual control, their speed being adjusted from time to time to hold atmospheric pressure in the furnaces. Storage-battery cars have been provided for removing ashes to the dump on the lake shore.

The 75-hp motors driving the forced-draft blowers which supply air to the furnaces are, as already noted, under automatic control, their speed being governed by Cutler-Hammer rheostats controlled by changes in the boiler pressure. The pressure in the air ducts beneath the boilers in turn controls the speed of operation of the stoker motors, which are under similar rheostatic control.

Reference was made to some of the novel features of the high-pressure steam piping in the Cleveland plant on page 1121 of our issue of May 1. The principal 14-in. header, 135 ft. long, is provided at its mid-point with an expansion loop made of four pipes bent U-shape, each pipe having one-half the diameter of the main pipe. The main header itself can be cut into three sections by means of Hopkinson-Ferranti valves. These interesting valves, which have clear openings only one-half the diameter of the steam main itself, employ the principle of the Venturi nozzle, the velocity of the steam as it approaches the restricted orifice being raised to a speed sufficient to pass the full quantity of steam with practically no drop in pressure across the valve. The walls of the main 14-in. steam header measure $\frac{5}{8}$ in. in thickness. All necks and flanges are welded. Long bends are used wherever turns are to be made.

Two of the 720-ft. head centrifugal pumps which force feed water into the boilers are driven by 125-hp and 150-hp motors, while the third 350-gal. unit, which

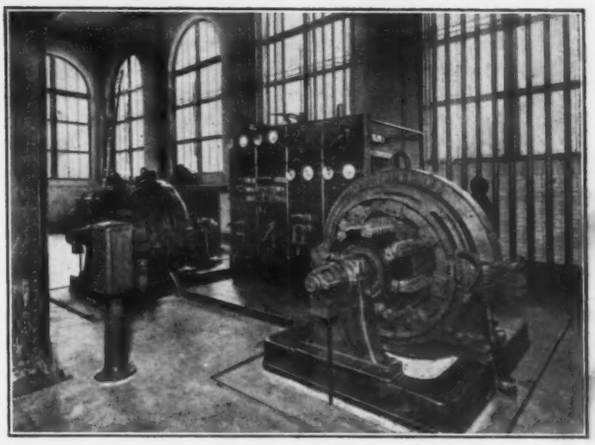


FIG. 9—ROTARY CONVERTER UNITS

is provided for emergency use, is operated by a Kerr steam turbine. By means of a governor set for constant pressure, this turbine-driven pump is arranged to deliver water to the boilers when the demand exceeds the output of the other electrically driven pump.

Installed in the Cleveland station at present are three 5000-kva, sixty-cycle, three-phase Allis-Chalmers horizontal steam turbines operating at 1800 r.p.m. The alternators generate at 5500 volts, this terminal pres-

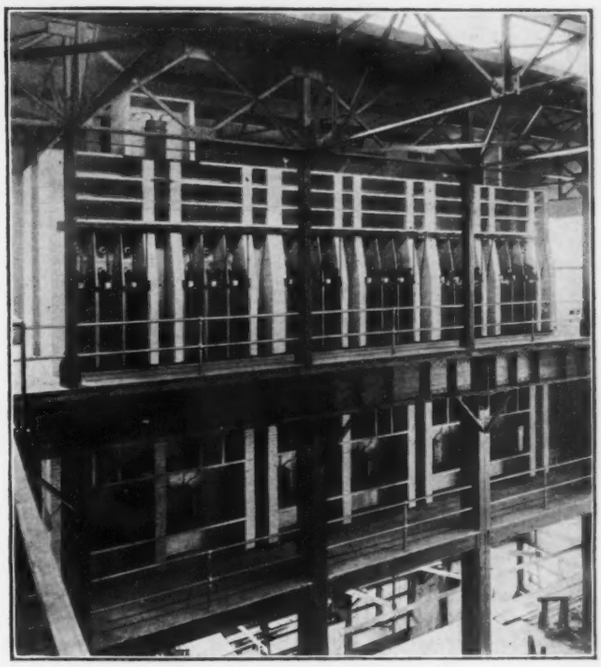


FIG. 10—HIGH-TENSION STRUCTURE AND SWITCHES

sure being stepped up through two-to-one transformers to 11,000 volts, the transmission potential.

Circulating water for the turbine condensers is taken from the city's 9-ft. water-supply tunnel, which extends five miles out under Lake Erie and takes its supply from a point 125 ft. below the surface of the water. Clean, cool water is thus assured for the surface condensers at all times of the year. After passing through the brass tubes of the condenser, this water, warmed a degree or two, is delivered to the city mains.

The 200-kw Westinghouse exciter turbine operates at 3600 r.p.m., driving through a Melville-McAlpine gear the direct-current exciter generator, which runs at a speed of 900 r.p.m.

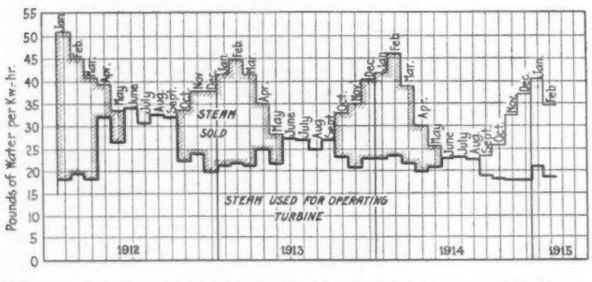
One of the most interesting and useful features of the layout of the Cleveland station is the elaborate arrangement by which indicating and recording instruments installed in the office of the chief engineer of the plant enable that official to keep in close touch with the operation of all parts of the station. Graphic recording meters show the total kilowatt output of the plant, voltage, etc., for the last twenty-four hours. Bristol recording thermometers show the temperature of the steam in the header, the temperature of the feed water passing to the economizers and from the economizers, and the temperature of the flue gases entering the economizer and leaving the economizer. The gases as they enter the stack are ordinarily reduced in temperature to from 160 deg. to 200 deg. Other recording instruments show the steam pressure in the mains, etc.

A float connection with a Lea V-notch recorder below the engineer's office gives an indication and record of the amount of feed water entering the boilers. The percentage of carbon dioxide in the flue gases is continuously registered by a Simmance-Abady CO_2 recorder, the readings of which are checked from time to time with an Orsat apparatus.

Mr. Frederick W. Ballard is commissioner and chief engineer of the light and heat division for the city. Mr. A. B. du Pont acted as consulting engineer in the design and construction of the plant. Mr. Foster McKenzie is the engineer at the plant in charge of operation.

Steam Consumption of a Bleeder Turbine

One of the greatest advantages of the bleeder-type turbine, as pointed out by Mr. F. W. Laas, of the Iowa Railway & Light Company of Cedar Rapids, Ia., is the fact that such a unit, in time of sudden peak load or in



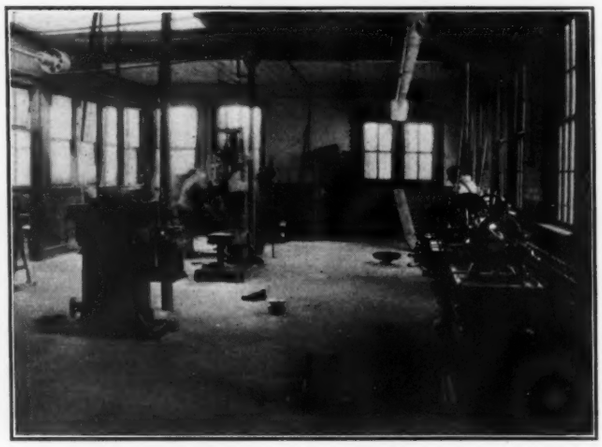
WINTER AND SUMMER STEAM CONSUMPTION OF 1500-KW BLEEDER TURBINE

case of accident in the boiler room, can be operated condensing for a short period. By this procedure the entire electric load can be carried continuously and the steam load can be dropped for the short interval required to restore normal operation.

On a curve which is reproduced herewith Mr. Laas showed records of the specific steam consumption of a 1500-kw bleeder turbine, capable of bleeding 24,000 lb. of steam per hour at 5-lb. gage. This machine has been in operation on the lines of the Iowa Railway & Light Company for four years. It will be noticed from this curve that the steam consumption during the non-heating period is about 22.5 lb. per kw-hr. During the heating season the specific steam consumption of this unit is lower than during the summer months. The fact that the unit has shown continually increasing efficiency during its period of service is due, said Mr. Laas, to the fact that the machine has been operating with more favorable load-factors each succeeding year.

A Convenient Power-House Machine Shop

In an addition which has been constructed at one end of the generating station of the Union Electric Company at Dubuque, Ia., is a machine shop which has proved a money saver for the company. During the last two years some rather extensive alterations have been in progress at the power house, and in that time the shop has saved the company enough to pay off nearly twice the amount invested in it. All of the power-house repairing, work on armatures and on machine parts, pipe cutting and threading, and general alteration work has been done in the shop. One journeyman machinist is regularly employed, and he is provided with whatever help he needs from the regular station force.



MACHINE SHOP OF UNION ELECTRIC COMPANY, DUBUQUE

EQUIPMENT OF POWER HOUSE MACHINE SHOP

Machine	Size	Location	Motor Size, Hp
Lathe	16-in.	Machine shop	0.75
Drill press	20-in.	Machine shop	1.00
Drill grinder			
Cut-off saw			
Radial drill	36-in.	Machine shop	5.00
Shaper	16-in.		
Lathe	24-in.		
Pipe threader	8-in. max.	Forge shop	5.00
Emery wheel		Forge shop	1.00
Forge		Forge shop	
Total, eleven machines			12.75

As will be seen from the illustration herewith all of the machine tools are placed in accessible positions and ample natural light is provided. An I-beam over the larger lathes serves as a support and runway for traveling chain falls used to raise and lower heavy pieces to be worked on in the machines. A list of the machine tools in this shop and in the forge shop beneath it is given in the accompanying table.

Convenient Operating Reports for Steam Plants

Simple Records Made by Operating Engineers, Oilers and Firemen Used to Increase Efficiency of Plant

THE men in the generating and boiler rooms of a plant are seldom too busy to devote a few minutes each hour to entering on suitable forms such readings as show operating conditions and make an efficiency study of the plant possible. However, many operating men have never been trained in the mathematical theory underlying machine operation, and any system of obtaining data must be so designed as to reduce the work of such men to the mere taking and entering of simple readings.

The Richmond Light & Railroad Company, New Brighton, N. Y., has devised a system of obtaining and keeping operating data which has proved convenient and effective. The work of the power-plant employees in the gathering of this information is confined to the reading of meters, scales, etc., and the entering of the figures thus obtained on special forms. These forms are turned into the office each day, computations made and curves plotted. Every morning an operating conference is held which is attended by the chief engineer and his assistants, the chief operating engineer, the statistician and the head of the company's laboratory. When necessary, power-plant employees are also called into the conference. Here the operating records for the previous day are discussed, and any errors such as those due to the cutting in or out of a boiler or a generator are called to the attention of the person responsible. Excessive amounts of coal, oil and other materials used can also be detected in this way and the causes investigated to locate the seat of trouble.

In Fig. 1 the data sheet employed in the boiler room is shown. Separate sheets are used for each of the three shifts per day. These indicate what boilers are in operation, those that are banked, the time when fires are

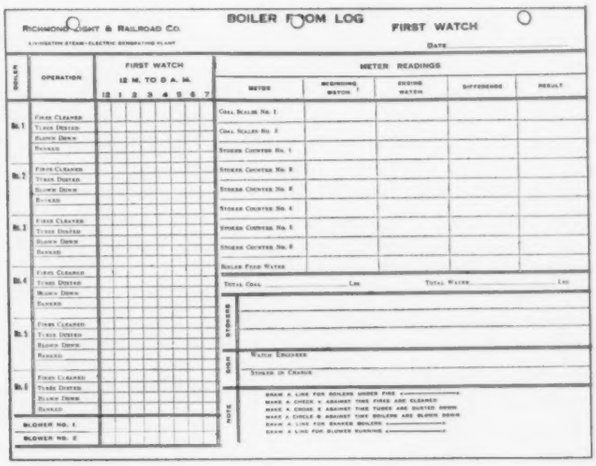
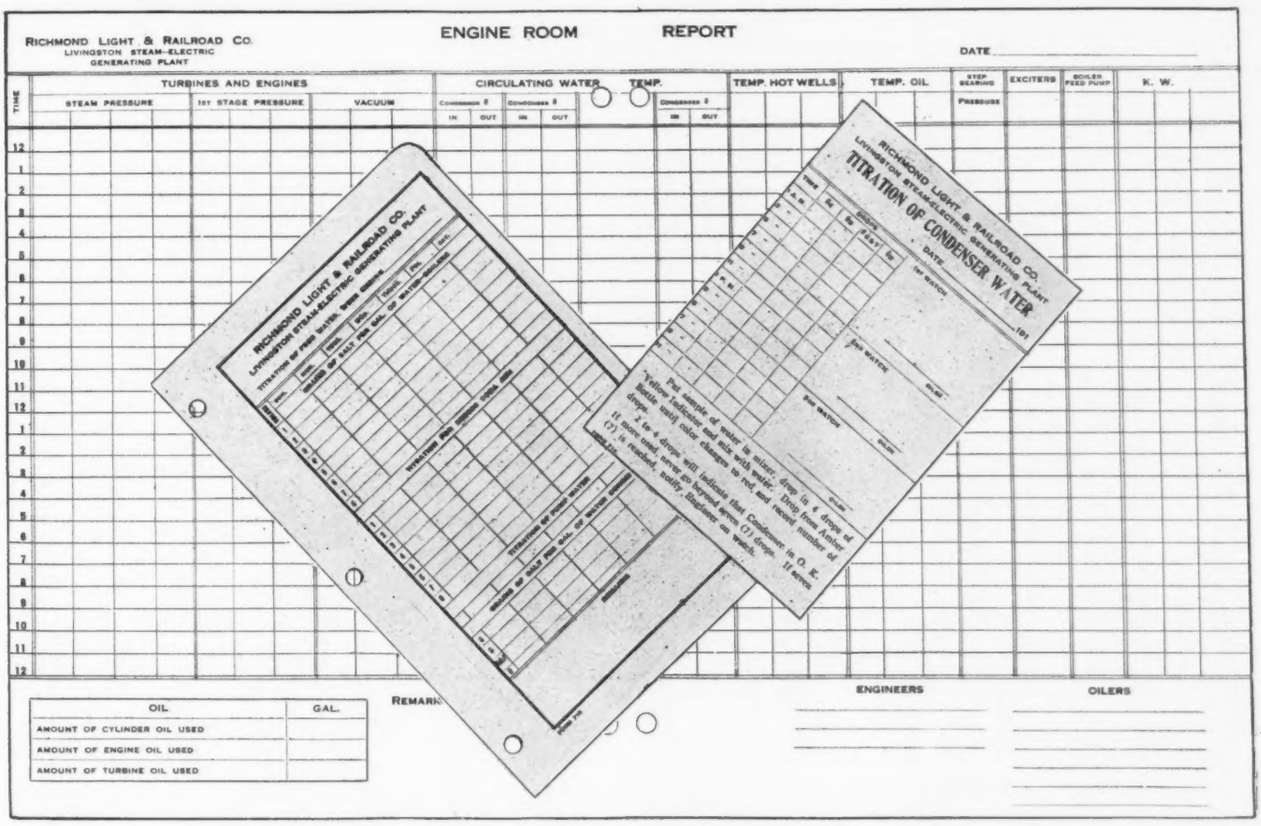


FIG. 1—BOILER-ROOM LOG FOR EACH WATCH, SHOWING COAL AND WATER USED AND CONDITION OF BOILERS

cleaned, the time when tubes are dusted down, and the times when the boilers are blown down. The coal used is weighed on the main coal scales and on the stoker



FIGS. 2, 3 AND 4—ENGINE-ROOM REPORT, SHEETS USED IN TITRATION-RECORD BOOK, AND TITRATION CARD USED BY OILERS

counters, one of which is provided for each boiler. The boiler-feed water is also measured. The taking of coal and boiler-feed-water readings at the beginning and end of a watch enables the amount of coal and feed water used during an eight-hour shift to be determined.

Boiler-Feed-Water Records

Considerable trouble has been experienced at this plant owing to the presence of salt in the boiler-feed water. In order to keep an accurate check on the condition of the surface condensers, therefore, the oilers are required to take samples of the water every hour and to perform simple operations to get some idea of the amount of salt in the condensed water. For this purpose small test tubes are employed. These are fitted into a metal holder upon which a line is marked corresponding to 5 cu. cm of liquid in a test tube that fits the holder. The oiler has only to take a sample of the water filling the test tube with the water up to the indicated mark. He has instructions to drop four drops of "yellow indicator," which is potassium chromate, into the test tube containing the sample of water, and then add drops from the "amber bottle," which contains silver-nitrate solution, until the color of the sample of the water turns to red. He then records on the form shown as Fig. 4 the number of drops of the second liquid employed. If seven drops of the second liquid are required to change the color of the water to red, it is a sign that the water contains excessive salt, and the oiler has printed instructions to notify the engineer on watch in such a case. In the form shown as Fig. 4 the vertical columns headed 4, 5, 6, 7 and 8 refer to the number of the condenser in operation and from which the sample of water was taken.

Weekly records of the titration of the boiler-feed water are maintained in a loose-leaf book on forms such as shown in Fig. 3. Soda ash is employed for dissolving the salt, and for this reason space is provided on these blanks for the "titration for excess soda ash."

Engine-Room Report

The engine-room report shown as Fig. 2 is printed on the interior of a folder upon the face of which (Fig. 5) a summary of the daily operating report is made. With the exception of the three columns to the right,

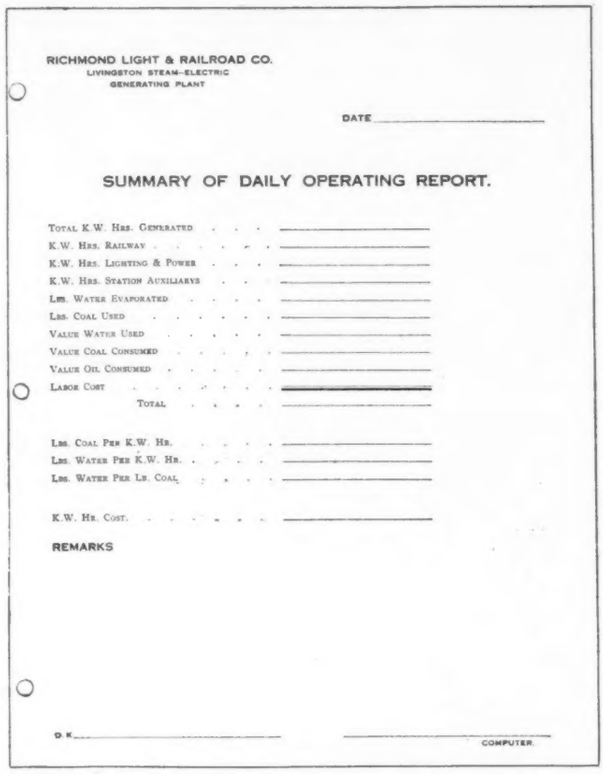
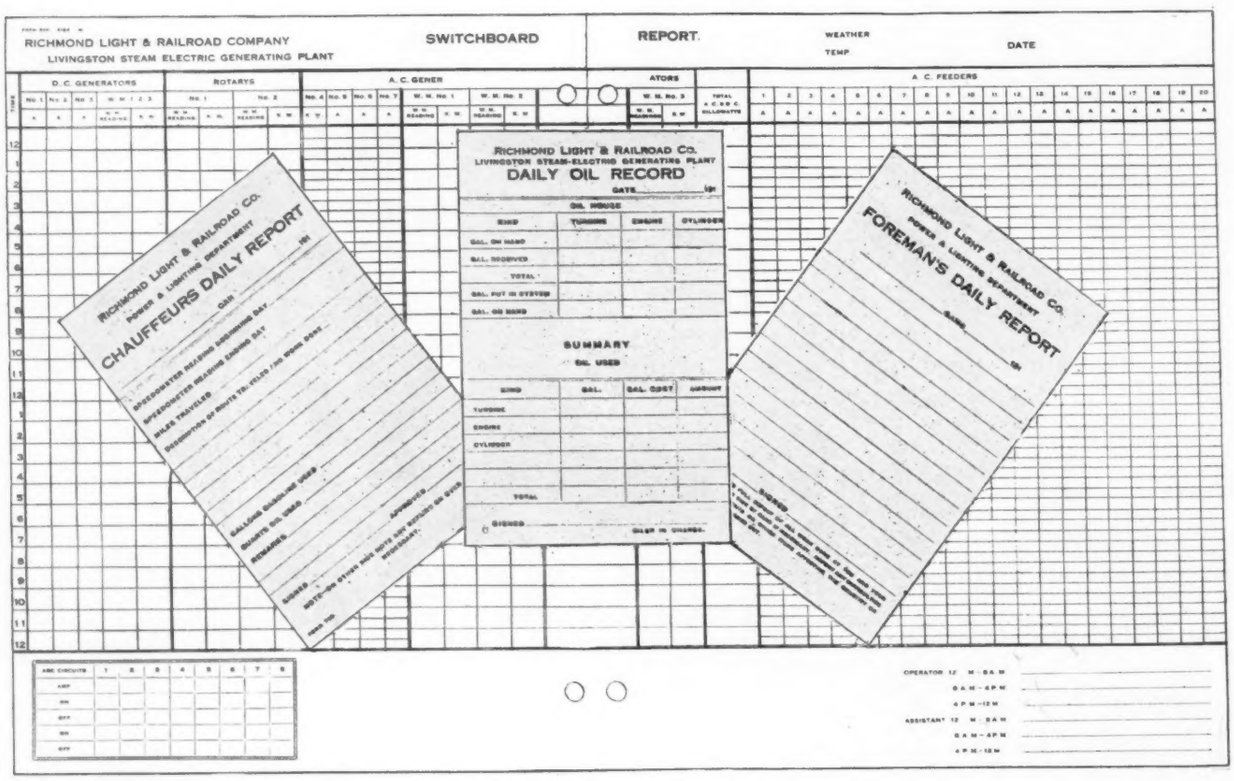
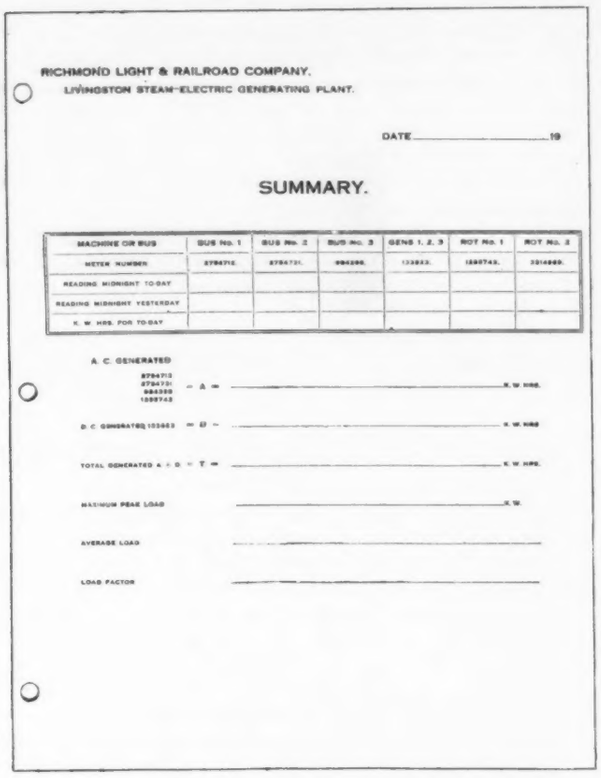


FIG. 5—COVER OF ENGINE-ROOM-REPORT FOLDER



FIGS. 6, 7, 8 AND 9—SWITCHBOARD REPORT, CHAUFFEUR'S DAILY REPORT, DAILY OIL RECORD, AND FOREMAN'S DAILY REPORT

this form is self-explanatory. In the column headed "Exciters" kilowatt-hour readings of the energy supplied to the exciters are entered. The column headed



RICHMOND LIGHT & RAILROAD COMPANY.
LIVINGSTON STEAM-ELECTRIC GENERATING PLANT.

DATE _____ 19

SUMMARY.

MACHINE OR BUS	BUS No. 1	BUS No. 2	BUS No. 3	GENS 1, 2, 3	ROT No. 1	ROT No. 2
METER NUMBER	2794712.	2794731.	994396.	133823.	1895743.	2014969.
READING MIDNIGHT TO-DAY						
READING MIDNIGHT YESTERDAY						
K. W. HRS. FOR TO-DAY						

A. C. GENERATED
2794712
2794731
994396
1895743
— A = _____ K. W. HRS.

D. C. GENERATED 133823 = D = _____ K. W. HRS

TOTAL GENERATED A + D = T = _____ K. W. HRS.

MAXIMUM PEAK LOAD _____ K. W.

AVERAGE LOAD _____

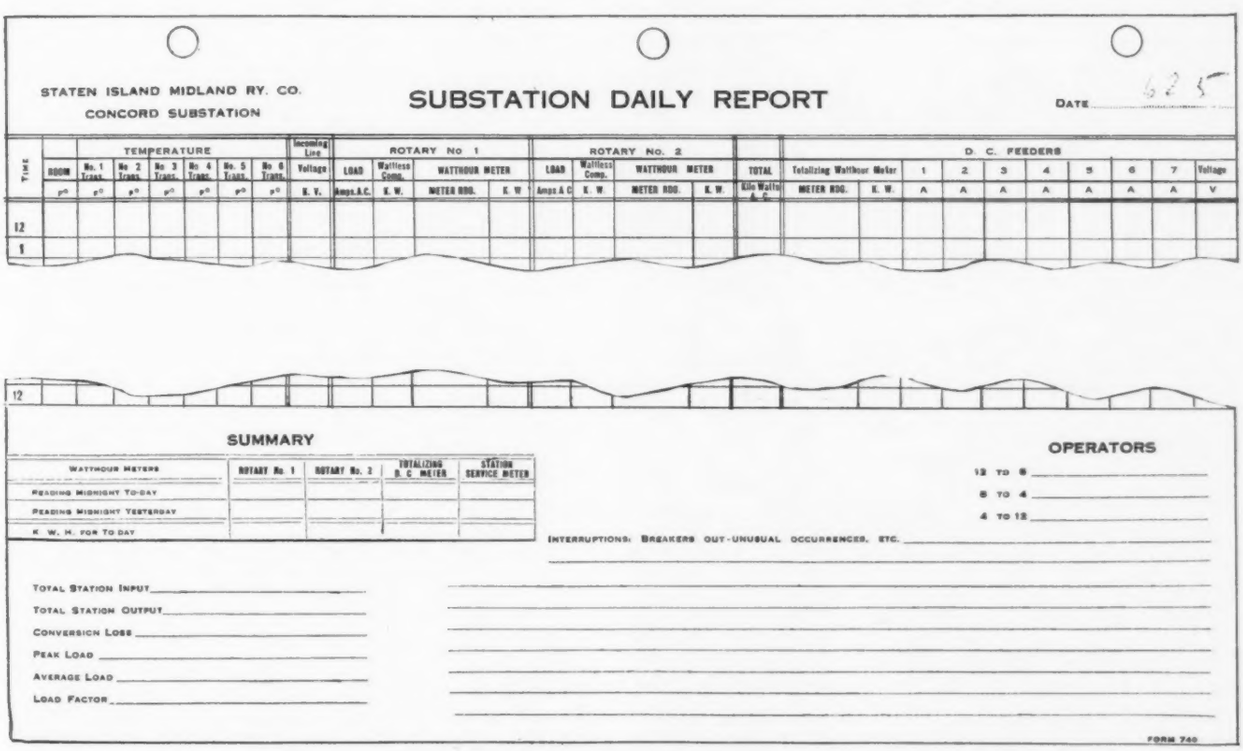
LOAD FACTOR _____

FIG. 10—FACE OF SWITCHBOARD-REPORT FOLDER

"Boiler-Feed Pump" is used to enter the amount of water delivered by the boiler-feed pump in pounds. The columns headed "Kw" are used for the purpose of entering the direct-current, alternating-current and total kilowatt-hours of electrical energy that have been generated in the twenty-four-hour period.

Switchboard Report

In Figs. 6 and 10 the interior and exterior sides of a folder used for the switchboard report are shown. This folder is identical in size with that shown in Figs. 2 and 5 and is inserted in the latter folder. On these forms are entered the ampere and watts output of the direct-current generators, rotary converters and alternating-current generators and the input to the alternating-current feeders and arc-lamp circuits. On the cover of this folder the kilowatt-hour readings as indicated for the various buses, generators and rotary converters are entered. On the back of the folder are entered any unusual conditions, such as break-downs, etc. The cover of the folder containing these forms is shown in Fig. 5, and contains on its interior the engine-room report as previously explained. On the face of this folder the total kilowatt-hour records and cost records for the previous day are given. These data are then plotted on a curve sheet shown in Fig. 12. This sheet is made translucent so that blueprints can be made at any time of any set of curves. In the upper part of these curve sheets are plotted curves showing the boiler horse-power, the total number of kilowatt-hours generated, and the percentage of boiler rating results. Space is also provided for giving the load-factor and the average load on the boilers. On the lower part of the curve sheets are indicated the periods during which the various boilers and generators were in operation. This is done by drawing horizontal lines between the vertical lines representing the times of starting and shutting down a unit. At the extreme bottom of these curve sheets space is provided for giving data such as are indicated in Fig. 12. The curves are drawn in a number of colored inks so as to distinguish the different quantities represented, and they are made every morning from the previous day's record.



STATEN ISLAND MIDLAND RY. CO.
CONCORD SUBSTATION

SUBSTATION DAILY REPORT

DATE 6 2 5

TIME	TEMPERATURE: ROOM	No. 1 Trans.	No. 2 Trans.	No. 3 Trans.	No. 4 Trans.	No. 5 Trans.	No. 6 Trans.	Incoming Line: Voltage	ROTARY No. 1: LOAD Amps A.C.	Wattless Comp. K. W.	WATTHOUR METER: METER RDG.	K. W.	ROTARY No. 2: LOAD Amps A.C.	Wattless Comp. K. W.	WATTHOUR METER: METER RDG.	K. W.	TOTAL Kilo Watts A. C.	D. C. FEEDERS: Totalizing Watthour Meter: METER RDG.	K. W.	1 A	2 A	3 A	4 A	5 A	6 A	7 A	Voltage V
	°	°	°	°	°	°	°	K. V.																			
12																											
1																											

12

SUMMARY

WATTHOUR METERS	ROTARY No. 1	ROTARY No. 2	TOTALIZING D. C. METER	STATION SERVICE METER
READING MIDNIGHT TO-DAY				
READING MIDNIGHT YESTERDAY				
K. W. H. FOR TO DAY				

OPERATORS
12 TO 8 _____
8 TO 4 _____
4 TO 12 _____

INTERRUPTIONS: BREAKERS OUT-UNUSUAL OCCURRENCES, ETC. _____

TOTAL STATION INPUT _____
TOTAL STATION OUTPUT _____
CONVERSION LOSS _____
PEAK LOAD _____
AVERAGE LOAD _____
LOAD FACTOR _____

FORM 740

FIG. 11—FORMS OF THE SUBSTATION DAILY REPORT, SHOWING ROOM AND TRANSFORMER TEMPERATURES, LOADS ON CONVERTERS AND FEEDERS, AND SUMMARY OF CONDITIONS FOR TWENTY-FOUR HOURS

These sheets are then used as a basis of discussion at the daily operating meetings attended by the chief engineer and his assistants, the chief operating engineer, the statistician and the head of the company's laboratory. Here the entire previous day's record is subjected to severe study and criticism, errors in operation being called to the attention of the persons responsible and means for bettering the efficiency of operation discussed. When subjects are discussed about which sufficient data are not at hand, the operating engineer, chief fireman or any other person directly connected is called into the meeting to furnish this additional information and to take part in the discussion. In this way the members of the operating committee are not only able to increase the efficiency of the plant but the men throughout the plant know that their performance is subjected to severe criticism and naturally attempt to operate the machinery intrusted to them in the most economical manner.

After these curve sheets showing the plant analysis from day to day have been discussed they are filed in a loose-leaf book which enables the engineering staff to make comparative records for different days and to study the factors affecting such records.

Miscellaneous Data

In Figs. 7, 8 and 9 forms are shown that must be turned in each day by the chauffeurs, oilers and foremen. The first of these forms is self-explanatory. On the back of the daily oil records, spaces are provided for detailed readings for the turbine oil system, the engine oil system and the cylinder oil system. Under these headings, such items as "oil in filter system," "oil in cooler," "oil in supply tank" and "oil added" are given and their totals found. Two additional items are given, namely, "oil used" and the "balance on hand." The first of these is obtained by subtracting the latter from the total oil that was on hand.

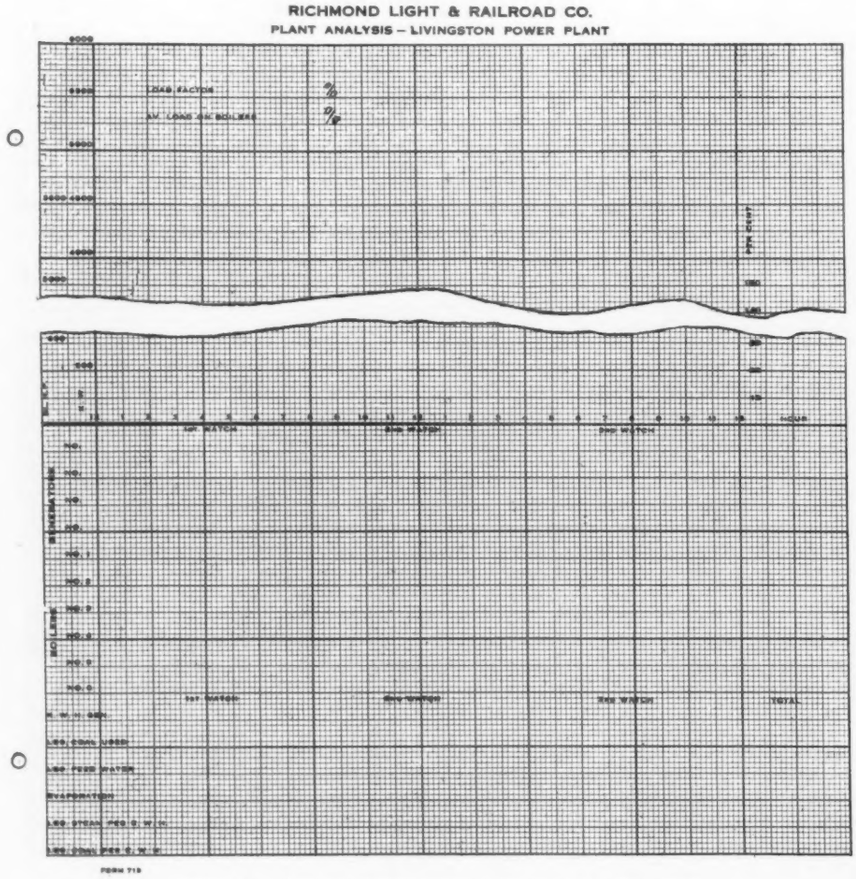


FIG. 12—CURVE SHEET USED FOR PLANT ANALYSIS

Fig. 11 shows the forms used for daily reports on substation operation. On these reports are entered the temperatures of the rooms and transformers, the loads and wattless components of the loads and the watt-hour readings corresponding to the rotary converters, the current and voltage readings for the various direct-current feeders, and the total watt-hours of electrical energy supplied to the feeders. From these data the summary given in the lower left-hand corner of the form can be derived. These sheets are filed in a special folder containing all data on the substations.

Logs are also kept showing the date, cost and nature of repairs or alterations made to any of the company's property or its equipment. The usual records made by recording instruments are also filed.

Important Points When Installing Motor-Operated Valves

The economy in operating large valves by motors is in most cases obvious from their location or functions. To realize fully the usefulness and maintain the efficiency of the motor-driven unit, however, there are important considerations in the selection and control of the motor. As an illustration, it is most desirable that emergency valves operate positively, especially when they cannot be reached quickly or when opening or closing them by hand would endanger the life of the operator. Installations falling in this class include valves in throttles, steam headers and supply lines.

Motors for operating valves should have a high starting torque, but not attain a speed after unseating the valve high enough to wreck it in overcoming the inertia of the motor at the end of the travel. There is the same objection to any "lost motion" in the connections. Series direct-current motors have been successfully employed with automatic control that inserts resistors in the motor circuit after the valve is unseated. In other cases polyphase alternating-current motors have been used.

To insure a valve being closed tightly without jamming, the motor must be brought to a standstill gradually. Limit switches when used for this service must be accurately adjusted. In some cases automatic switches are used in the motor circuit so that an increased current caused by stopping of the motor opens the circuit. On account of the widely fluctuating load existing when a valve is being closed, however, it is often difficult to determine how to set the circuit-breaker relay. Another objection to this control is that the motor can be started in the wrong direction, thereby jamming the valve more tightly. An excellent plan, and one used on some remote-controlled motor-operated valves, is to use pilot lamps and revolution counters to show the exact position of the valve, the nature of this arrangement depending on the operator's ingenuity.

Use of Electricity in a Newspaper Plant

Motor and Control Equipment for Production of New York Times—Rotogravure Presses and Apparatus for Changing Rolls While Presses Run

THE Times Annex, New York, is a twelve-story building designed especially for the rapid and efficient production of a large metropolitan daily newspaper. It is the home of the *New York Times* and has supplanted the famous Times Building in Times Square, a scant half-block away. The electrical equipment is representative in its completeness. Wherever possible apparatus has been duplicated to reduce the number of interruptions to service. Direct-current energy is obtained from the New York Edison mains, the motors operating at 240 volts and the lamps at 120 volts.

Press Equipment

The main pressroom, which is in the basement, has an area of approximately 17,000 sq. ft. In this room are four double-sextuple Hoe presses and one double-octuple Hoe press, all of which rest on solid-rock foundations. A total of 372,000 twenty-four-page papers can be printed an hour with these presses under ordinary operating conditions, representing a consumption of a ton of paper a minute. Besides being utilized for printing newspapers, the octuple press is employed for high-grade printing such as magazine work. In addition to the main presses in the basement, there are three rotogravure presses on the sixth floor and two Cottrell presses on the seventh floor. The rotogravure presses print part of the Sunday pictorial supplement and a midweek picture number. They were made by the Maschinenfabrik Johannesberg, Geisenheim am Rhein, Germany. The Cottrell presses are employed in printing the major part of the Sunday pictorial section.

Each sextuple press consists of three double-width or four-page-wide printing units, and each unit is fed by a separate roll of paper. Six rolls of paper are required for each double-sextuple machine. Instead of being placed on brackets at the end of the presses, the rolls are mounted on a special reel in the sub-basement as shown in Fig. 2. Three rolls can be carried by this reel at one time, and by means of it a change in rolls can be effected while the press is running. The octuple press prints from four rolls of paper or less, the rolls being mounted on a reel similar to those on the sextuple presses. Any of the sextuple presses can be run as two separate sextuple machines, and the octuple press as two separate quadruple presses.

The sextuple presses and the octuple press are driven by Electro-Dynamic Company motors, two 60-hp to 80-hp machines and two auxiliary 5-hp to 7.5-hp machines being used at the side ends of each press. Two sets of motors for two of the sextuple presses are illustrated in Fig. 3. The motor equipment at either end is designed to drive the complete press for a period of three hours. Two of the rotogravure presses are operated by two 14-hp Sprague motors and two auxiliary 2-hp Sprague motors, and the third rotogravure press is driven by a single 10-hp Electro-Dynamic motor. One of the Cottrell presses is driven by a 15-hp Crocker-Wheeler motor and the other by a 10-hp Sprague motor.

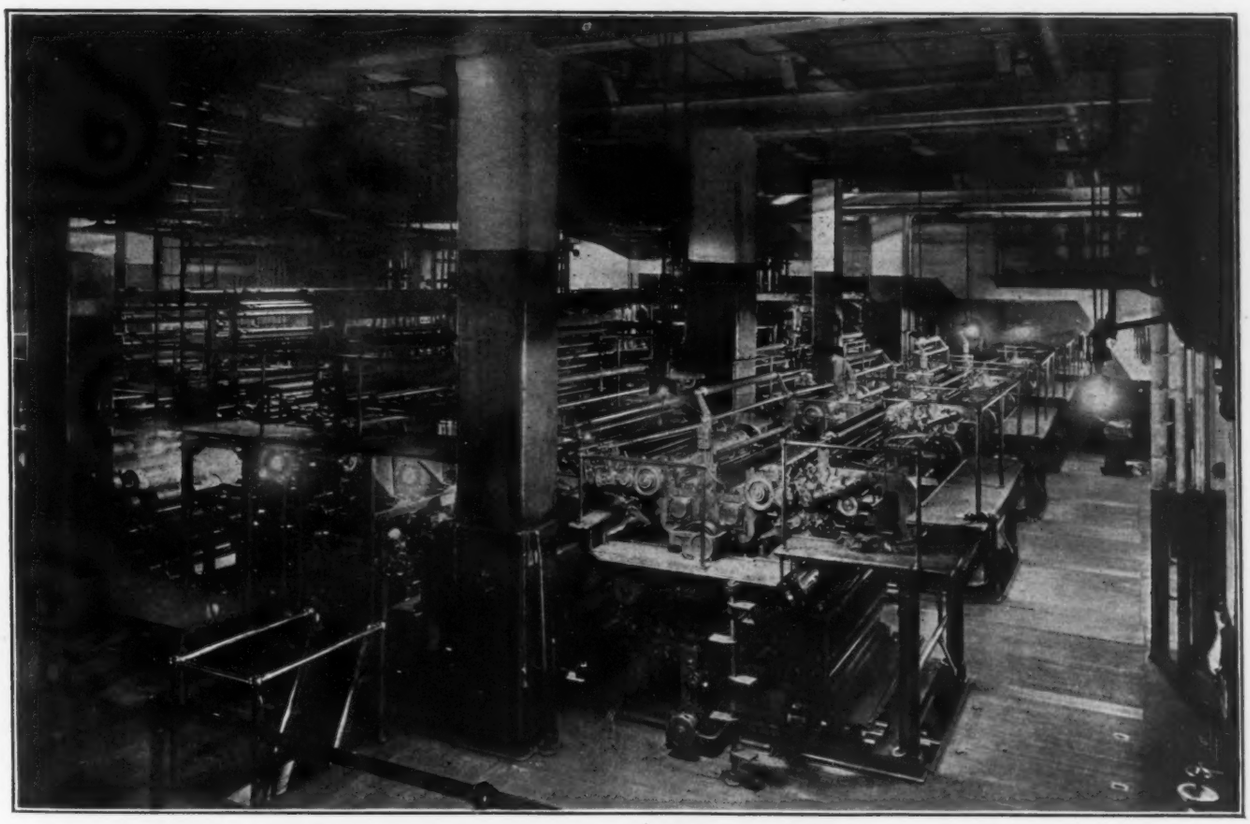


FIG. 1—MAIN PRESSROOM, CONTAINING FIVE MAMMOTH PRESSES EACH DRIVEN BY 175 HP IN MOTORS AND HANDLING 1 TON OF PAPER PER MINUTE

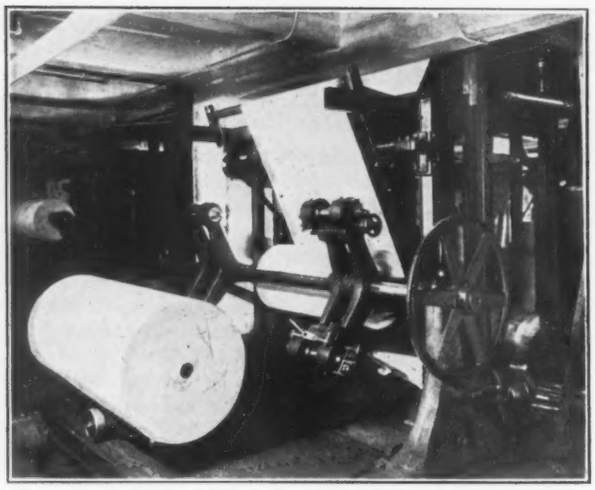


FIG. 2—SPECIAL MOTOR-OPERATED PAPER-FEED REELS

Ink for the printing presses in the main pressroom is stored in a tank 5.5 ft. in diameter and 12 ft. long, which is suspended from the ceiling. An air compressor operated by a 20-hp General Electric motor is employed to maintain a pressure of from 30 lb. to 50 lb. per sq. in. A trap opening through the floor of the delivery room is provided to allow the ink to drain off from ink barrels to the tank. Approximately a ton of ink is used for a single run.

Push-Button Control System

All of the presses are equipped with Kohler push-button control apparatus. In Fig. 7 is shown the control equipment for the four double-sextuple presses. Each of the presses has twenty-six push-button stations. Every station is equipped with five buttons which are designated respectively as the "on," "stop," "off," "run" and "safe" buttons. On pushing the "on" button the press is started, and if the button is maintained in the depressed position the speed is gradually increased until maximum speed is attained. If the button is released before the latter speed is reached, the press continues to operate at the speed at which it was operating when the button was released. In cases of emergency, or when it is desired to stop the press quickly, the "off" button is depressed, and if the machine is running at full speed a full stop can be accomplished in four seconds. Ordinarily, however, the press is stopped by pressing the "off" button, and the speed is

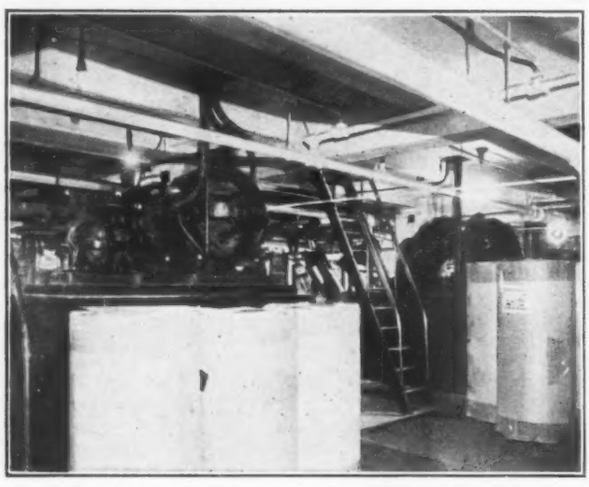


FIG. 3—PART OF MOTOR EQUIPMENT FOR TWO SEXTUPLE PRESSES IN SUB-BASEMENT

MOTOR EQUIPMENT FOR TIMES ANNEX

Floor	No. of Motors	Rating of Single Motor in Hp	Total Rating in Hp	Make	Operation
Twelfth	4	60	240	Otis	Elevators
	4	0.25	1	Holtzer-Cabot	Signals
Ninth	1	0.5	0.5	Sprague	Proof press
	1	3	3	Sprague	Paper cutter
	2	0.25	0.5	Sprague	Linotype machines
	1	1/6	1/6	Robbins & Myers	Multigraph
Eighth	1	3	3	Sprague	Carpenters' saw
Seventh	1	15	15	Crocker-Wheeler	Cottrell press
	1	10	10	Sprague	Cottrell press
	1	3	3	Diehl	Paper cutter
	1	3	3	Sprague	Paper cutter
	2	2	4	Crocker-Wheeler	Folders
	1	2	2	Sprague	Folders
	2	1	2	Sprague	Folders
	1	0.25	0.25	Chapman	Neutralizer
	2	0.25	0.5	Sprague	Cottrell delivery lift
	1	0.25	0.25	Sprague	Tippen winder
	1	0.5	0.5	Sprague	Tippen winder
	4	1/6	2/3	Peerless	Stitchers
	2	1/6	1/3	Eck	Drying fans
Sixth	2	14	28	Sprague	Rotogravure presses
	2	2	4	Sprague	Rotogravure presses
	1	10	10	Electro-Dynamic	Rotogravure press
	1	0.25	0.25	Chapman	Neutralizer
	4	0.25	1	Sprague	Cylinder-drying blowers
	7	1/6	1 1/6	Eck	Drying fans
	1	7.5	7.5	Sprague	Ventilating fan
	1	3	3	Sprague	Grinder
	1	3	3	Sprague	Polisher
	1	0.25	0.25	Sprague	Print driers
	1	0.25	0.25	Emerson	Printing-frame suction fan
Fifth	1	0.25	0.25	Fidelity	Potato peeler
	1	0.25	0.25	Rosenfield	Vacuum cleaner
	1	1	1	Triumph	Ice-cream freezer
	1	5	5	Sprague	Ventilating fans
Fourth	40	0.25	10	Sprague	Linotype machines
	12	0.25	3	Cushman	Linotype machines
	1	0.25	0.25	Jenny	Lintoype machine
	1	5	5	Sprague	Ventilating fan
	1	0.25	0.25	Holtzer-Cabot	Ventilating fan
	1	0.25	0.25	Sprague	Ventilating fan
	1	3	3	Jenny	Steam table
	1	1/8	1/8	Hisy-Wolf	Grinder
	1	0.75	0.75	Crocker-Wheeler	Lathe
	3	3/6	1 1/8	General Electric	Monotype machine
	1	5	5	Sprague	Steam table
	1	0.5	0.5	Miller	Saw
	1	0.25	0.25	Holtzer-Cabot	Linotype monitor
	2	1/6	1/3	Holtzer-Cabot	Linotype monitor
	2	0.5	1	Diehl	Copy carrier
	1	8.5	8.5	Westinghouse	Air compressor for steam table
	1	3	3	General Electric	Double-page proof press
	1	0.5	0.5	Sprague	Matrix hoist
	1	0.5	0.5	Burdette-Rowntree	Cut lift
	2	0.25	0.5	Sprague	Proof press
	3	0.25	0.75	Peerless	Ventilating fans
	1	0.5	0.5	General Electric	Blower
	1	0.25	0.25	Eck	Melting-pot blower
Third	8	1/8	1	Holtzer-Cabot	News machines
First	8	1	8	Sprague	Paper conveyors
	8	0.25	2	Peerless	Moving tables
Basement	1	20	20	General Electric	Air compressor
	5	10	50	Jenny	Autoplate machines
	3	3.5	10.5	Jenny	Autoshaver
	2	1	2	Crocker-Wheeler	Flat shaver
	2	0.5	1	Sprague	Saws
	1	0.5	0.5	Crocker-Wheeler	Side trimmer
	2	1	2	Jenny	Blower
	2	1	2	Sprague	Blower
	1	1/6	1/6	Peerless	Melting-pot blower
	1	1/6	1/6	Sprague	Emery-saw grinder
	1	1	1	Sprague	Ventilating fan
	1	2	2	Sprague	Machine-shop lathe
	1	4	4	General Electric	Shaper
	1	1/8	1/8	Peerless	Saw
	1	0.75	0.75	General Electric	Drill press
	1	5	5	Sprague	Ventilating fan
	1	1	1	Sprague	Hoist
	1	10	10	Crocker-Wheeler	Press-room ventilating fan
	1	0.25	0.25	J.C.M. Co.	Scrubbing machine
	1	1	1	Sprague	Jig-saw
	1	1	1	Crocker-Wheeler	Router
Sub-basement	10	80	800	Electro-Dynamic	Presses
	10	7.5	75	Electro-Dynamic	Presses
	28	1.5	42	Sprague	Reel lift
	28	1	28	Sprague	Reel shift
	2	20	40	Sprague	House pumps
	1	25	25	Otis	Plunger elevator
	2	7.5	15	Sprague	Air compressor
	2	2.6	5.2	National	Sprinkler-system pumps
	1	7.5	7.5	C. & C.	Refrigerating machine
	1	1	1	Twinvolute	Drinking-water pump
	1	3	3	Roth Brothers	Portable paper lift
	1	12	12	Sprague	Cooling-water pump
	2	10	20	Sprague	Sump pumps
	1	1.5	1.5	Sprague	Hot-water pump
	1	1.5	1.5	Sprague	Steam-circulation pump
	1	0.75	0.75	Peerless	Vacuum pump
	1	0.25	0.25	Cushman	Armature-testing machine
	1	0.25	0.25	Sprague	Armature-testing machine
	1	0.5	0.5	Sprague	Shop lathe
	1	0.25	0.25	Holtzer-Cabot	Motor-generator
	1	0.25	0.25	Sprague	Ventilating fan

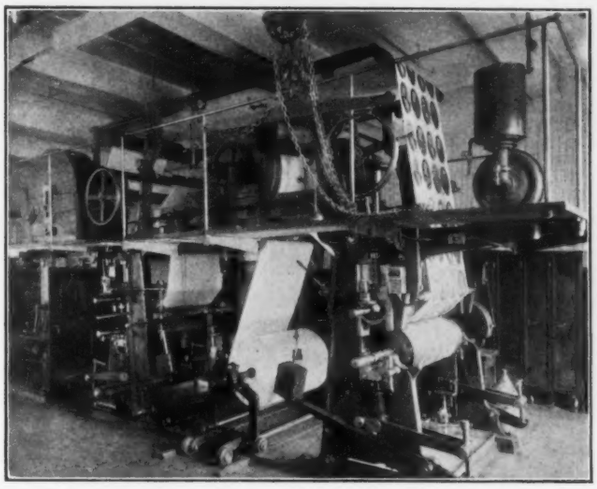


FIG. 4—ROTOGRAVURE PRESS FOR PRINTING ILLUSTRATED SUPPLEMENTS

decreased in the same number of gradations as it was increased while the "on" button was depressed. If the button is released before a full stop is attained, the press continues to operate at the speed at which it was running when the button was released. The "safe" button is pressed when workmen are on the press or when it is desired for any other reason to prevent the press from moving. In order to start the press after the "safe" button has been depressed it is necessary first to push the "run" button to release the "safe" button.

When both sides of a press are in operation the control mechanisms for the two sets of motors are connected by one of the cross-bars shown in Fig. 7. If only one set of motors is moving, the bar is disconnected and only the solenoid controlling that set of machines is in operation. In starting the presses the small motors are used. While the small motors are still running the large motors are connected. After a certain speed has been attained the small motors are disconnected and the presses are driven by the larger motors. For the sextuple presses there are twenty-eight speeds.

A mechanism for recording the movement of each press has been devised by Mr. Walter Palmer, chief electrician for the *New York Times*. A strip of paper is printed as shown in Fig. 11 and is placed on a cylinder which is rotated by a clock movement. A recording needle is so connected by a cord to the solenoid plunger that every increase or decrease in speed is registered on the paper by the pen. The record of a complete run is shown in Fig. 11. The record cylinders are inclosed in glass cases in front of the solenoids illustrated in Fig. 7.

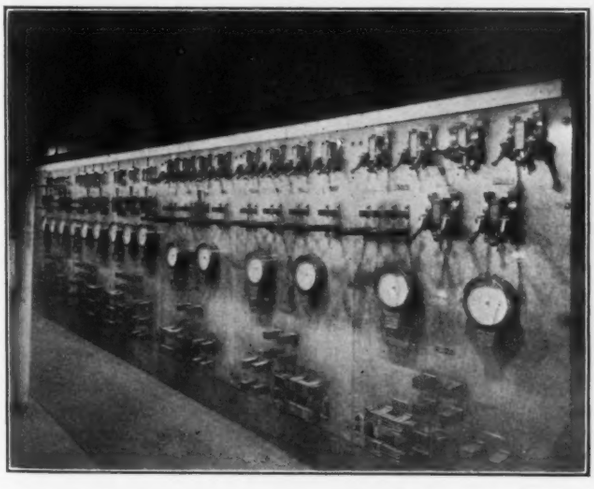


FIG. 5—MAIN SWITCHBOARD IN BASEMENT OF NEW YORK TIMES BUILDING

The octuple press is equipped with a control board similar to those shown in Fig. 7 and is provided with eight push-button stations. It operates at twenty-eight different speeds. Each of the rotogravure presses is provided with six push-button stations. One of the Cottrell presses has five push-button stations and the other four.

The Flying Splice

A feature of the operation of the large presses in the main pressroom is the method of changing the rolls, which are in the sub-basement, under the presses, while the presses are in motion, making what is called a flying splice. For this purpose the special reel already referred to is utilized. Twenty-eight reels are provided, and they hold eighty-four rolls, or 58 tons of paper. The reels are so constructed that one of the rolls is continually pressing against an endless belt, which gives the proper speed to the paper as it enters the press. When it is desired to change a roll, the end of the new roll is so cut that the middle comes to a point and the surface of the paper near the end of the roll receives a coating of paste. The speed of the press is decreased to a point where the small motor is just being placed in operation while the large motor is still running. A signal lamp is lit when this speed is attained. The reel is turned by a 1.5-hp motor until the new roll touches the belt, when the roll is rotated at the proper speed, and the end of the roll is pasted to the paper from the exhausted roll, which is cut as soon as the splice has been made. Another motor, rated at 1 hp, is utilized to move the reel when it is necessary to shift the margin. This motor is controlled by the operator from the pressroom floor.

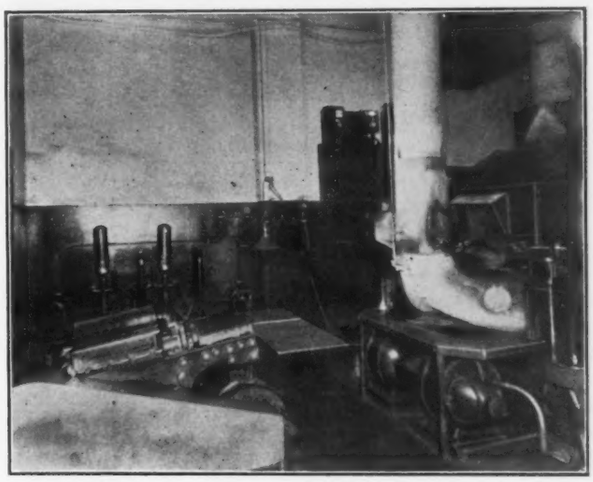


FIG. 6—MOTOR EQUIPMENT FOR A DOUBLE AUTOPLATE MACHINE

Nine paper conveyors, each of which is operated by a 1-hp Sprague motor, carry the folded papers directly from the press to the top of the pressroom, then horizontally for a short distance and deliver them finally, in lots of fifty copies, to the delivery room on the first floor.

Stereotyping Equipment

The stereotyping apparatus includes six pneumatic matrix-drying presses, equipped with independent gas-heated steam generators, two matrix-rolling machines, one air compressor, two double "junior autoplate" cast-

ing machines, two blowers, three "autoshaver" plate-trimming machines (one reserve), and a job plant. One matrix-rolling machine used with the steam-heated presses is operated by a 3-hp Jenny motor, and compressed air is supplied by an 8.5-hp Westinghouse railway air-compressor outfit. One rolling machine, together with the steam-heated presses, is shown in Fig. 9. The steam tables and rolling machines are on the fourth floor.

As soon as a matrix is ready it is sent down to the casting room in the basement by a special elevator conveyor designed by Mr. Walter Palmer. It is operated by a 0.5-hp motor and consists of two compartments or cars. When one car is at the fourth floor the other is at the basement, and vice versa. The conveyor is designed especially for quick operation, and one car descends from the fourth floor to the basement and the other ascends from the basement to the fourth floor in four seconds. By pressing a button on the fourth floor the conveyor is placed in operation and at the same

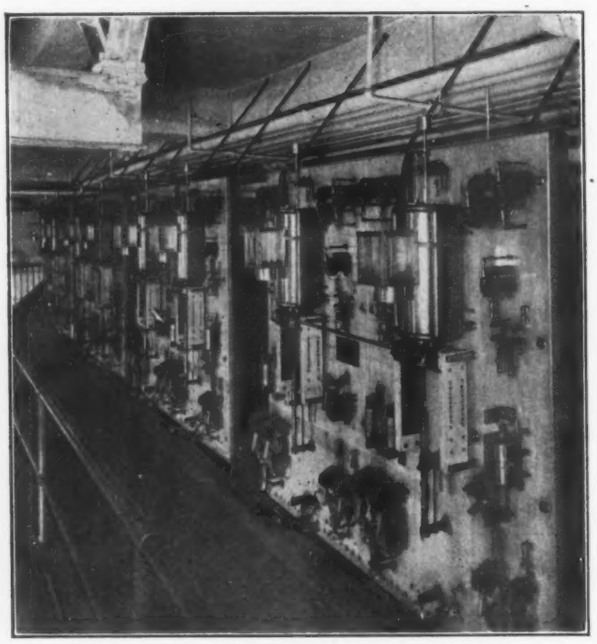


FIG. 7—CONTROL EQUIPMENT FOR DOUBLE-SEXTUPLE PRESSES OPERATED BY PUSH-BUTTONS

time a red lamp in the basement is lighted and a bell rung. The car cannot be returned until one of the workmen in the stereotyping room removes the matrix and pushes a switch. When the last matrix for a run is placed on the steam table an operator on the fourth floor turns a key switch which operates a gong and lights a colored lamp in the pressroom and another in the mailing room to give the men in these rooms warning that the plates will soon be ready for the press. The conveyor can be operated only from the fourth floor. A Burdette-Rowntree elevator conveyor is also used to carry cuts from the fourth floor to the stereotype room and back again.

The matrices are placed in the autoplate machines, each of which is equipped with two 10-hp Jenny motors. These machines are designed to turn out twelve plates a minute (three from each of four casting machines). The double "junior autoplate," as it is called, consists of a large melting pot, which holds 8 tons of molten metal, and two casting machines for the making of curved stereotype printing plates. The matrix is inserted in an upright casting chamber and about 80 lb. of molten metal is poured into the chamber. As soon as the metal is cooled sufficiently a bell is rung, and

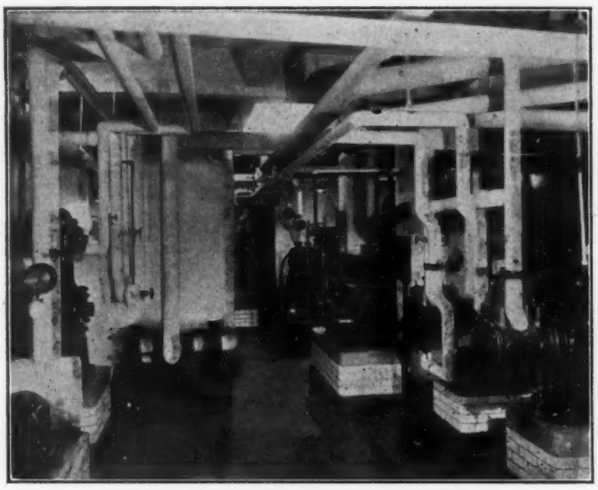


FIG. 8—PUMP ROOM IN SUB-BASEMENT OF THE TIMES ANNEX

after the tailpiece or riser is cut off the plate is carried to the autoshaver for further trimming. The autoshavers are driven by 3.5-hp Jenny motors. One of these autoshavers is designed to shape, shave, cool and dry six plates a minute. One machine is employed to serve two casting machines. At the right in Fig. 6 is shown part of one of the double autoplate machines with the motor equipment, and on the left of the illustration is shown an autoshaver. One set of blowers is also illustrated in the rear of Fig. 6. Beside the autoplate machines, autoshavers and blowers in the casting room, there is the jobbing equipment, which consists of side-trimmer, flat shaver, packing tables, shaper, saws, emery-saw grinder, router, etc.

Rotogravure Presses

As already stated, the rotogravure presses on the sixth floor were imported from Germany and were installed recently. Each press is equipped with two cylinders upon which copper shells are mounted and which rotate in a bath of ink. The copper shell is provided with an intaglio surface from which illustrations

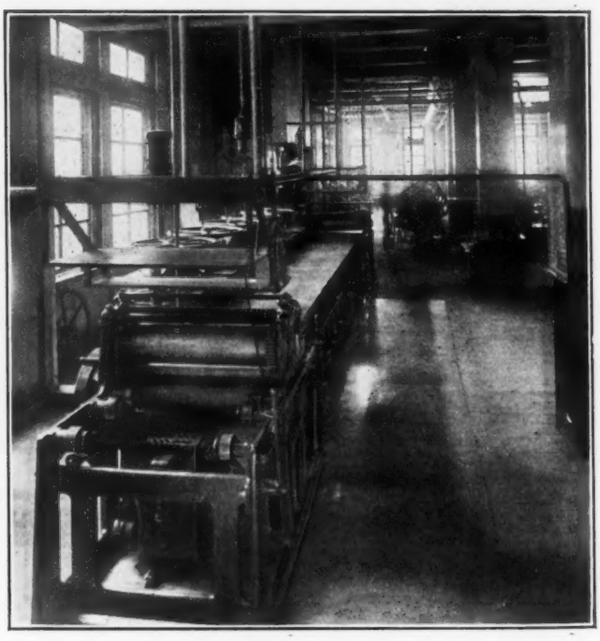


FIG. 9—ROLLING MACHINE IN COMPOSING ROOM DRIVEN BY MOTOR IN ITS BASE

of a rich hue and with deep shadows are printed. The surplus ink is removed from the surface of the cylinder by a sharp steel knife. Two cylinders are on each press to provide for printing both sides of the paper. After being printed on one side the paper is passed over a steam-heated cylinder to dry the ink. One of the rotogravure presses is illustrated in Fig. 4.

Pump Room

Cleanliness and orderliness of arrangement of equipment are characteristic of the Times Annex throughout, but nowhere are they more evident than in the pump room in the sub-basement, which is shown in Fig. 8. In this room are five screw-type Quimby pumps, two of which are for the general water supply of the building, one for the water-circulation system of the monotype and linotype machines on the fourth floor and the autoplate machines in the basement, and two for sump pumping. The motors with their ratings for driving these pumps are listed in the accompanying table. The remaining equipment in the room consists of an ammonia refrigerating system, an Otis elevator plunger pump with electrical control, a pressure tank and suction tank for plunger elevator, an air compressor for plunger elevator, two air compressors for ejector with electrical control, an air compressor for sprinkler system with electical control, and various tanks and filters.

Composing Room

The composing room is on the fourth floor, and a section of it is illustrated in Fig. 9. The latest equipment for promoting efficiency has been adopted, notable of which is the Zenke recording system, which provides for the registration on a chart of the various operations of each linotype machine. There are fifty linotype machines and two monotype machines. The Zenke monitor automatic duping machine is connected to each linotype machine, and automatically records on a roll of paper every line of type set by every machine and the time at which it was set. The chart also indicates the length of time a machine is not in operation. In the event of a machine getting out of order, the operator touches a button which lights a red lamp over his machine. It is possible, also, for each operator to signal to the copy desk by means of an annunciator. Carriers are provided for sending copy to the various machines, thus saving the operators the necessity of frequent trips to the "copy desk."

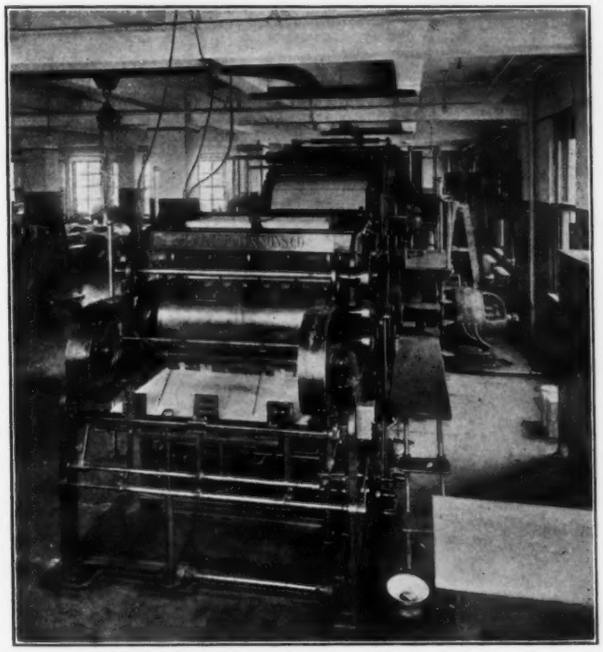


FIG. 10—PRESS FOR PRINTING SUNDAY PICTORIAL SECTION, WITH MOTOR AT THE SIDE

Miscellaneous Equipment

A wagon space inside the building line is provided for the easy transfer of paper from the trucks. The paper rolls are passed from the trucks to a platform and thence to a plunger hoist which carries them to the sub-basement, 37 ft. below. Each roll is about 32 in. in diameter and 73 in. long and weighs about 1400 lb. For handling the rolls in the sub-basement a portable paper lift which is operated by a motor of 3-hp rating is utilized.

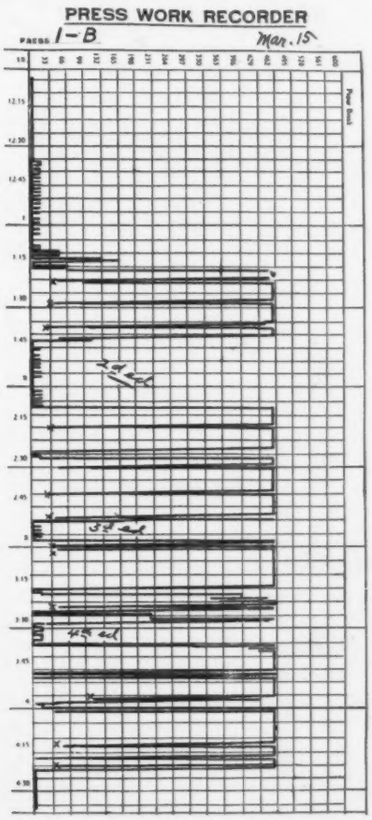


FIG. 11—GRAPHIC RECORD FOR A COMPLETE RUN OF A SEXTUPLE PRESS

The general electrical work in the Times Annex, such as wiring, laying of conduits, and installing lighting fixtures and a number of the motors, etc., was done by Mr. Harry Alexander. Mr. Charles F. Hart is mechanical superintendent for the *New York Times*, Mr. G. B. Moyer building superintendent, and Mr. Walter Palmer chief electrician.

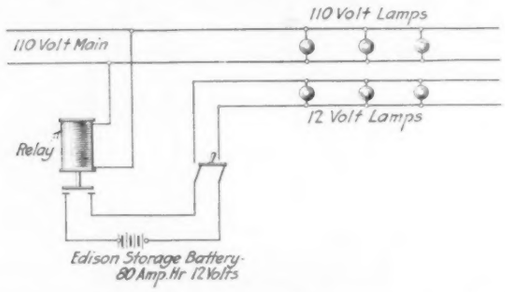
An Unappreciated Fire Hazard

Blotters that have been used for filtering transformer oil are naturally left in a highly combustible condition. Care and watchfulness should therefore be exercised during the drying period to prevent ignition of such material. The Pacific Gas & Electric Company, San Francisco, Cal., has recently experienced two fires in ovens apparently due to overheating blotters in the process of drying. The company advises that ovens used for this purpose should be situated away from walls and all material which might be ignited in case of a fire.

Operating Kinks

Emergency Battery Lighting for Substations

Risk incidental to operating switches in a dark substation following a short-circuit, such as sometimes occurs during bad weather, is eliminated by the use of the circuit here shown, devised by Mr. James F. Rogan, of Los Angeles, Cal., to use a stock relay and other ap-

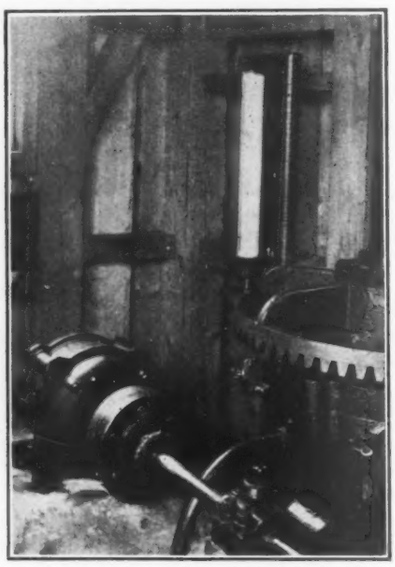


BATTERY CIRCUIT FOR EMERGENCY SUBSTATION LIGHTING

paratus available in the open market. The 12-volt nickel-iron battery will stand charged for a year without attention, always ready to respond instantaneously to a call for duty.

Scheme for Indicating Position of a Sluicegate

In many hydroelectric plants the operator cannot see the amount of sluicegate opening when manipulating the controlling mechanism. To overcome this an indicator has been devised and installed at the Dundee Falls (Maine) station of the Presumpscott Electric Company as shown in the accompanying illustration. The scheme consists of a pipe about 2 ft. long painted white

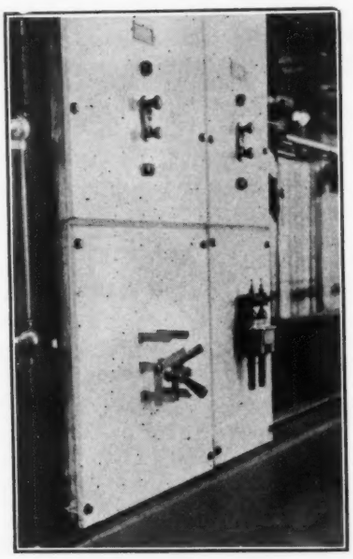


A DEVICE TO SHOW SLUICEGATE POSITION

and provided with a graduated slot in which a pointer travels on a screw shaft connected with the gearing of the gate and shows the amount of gate opening at any time. The gate gearing is operated by a motor, as shown in the illustration, and when standing at its controller the operator can follow the gate opening and closing and make adjustments according to the conditions without the usual guesswork and danger of blocking the motor or of leaving the gate in an undesirable position. Without such apparatus an automatic motor stop is usually necessary for safe service. With it the operation of the gate is not only made safe but the amount of gate opening is shown at all times.

Emergency Switch for Turbo-Alternator Field

To maintain continuous excitation of the fields of a 1500-kw turbo-alternator and to protect the plant exciters when the local storage battery is called upon to carry the excitation service, the Lowell (Mass.) Electric Light Corporation has installed an emergency switch, as shown in the accompanying illustration, on the



EMERGENCY FIELD SWITCH ON TURBO-ALTERNATOR PANEL

panel controlling the turbo set at its Perry Street station. In case of trouble on the exciter system, the operator at once transfers the alternator field to the battery by throwing the double-pole knife switch upward, the battery contacts being made before the ordinary exciter contacts are broken. This maintains the turbine unit's field independent of the exciter bus and avoids the danger of putting full battery voltage across the exciter commutator in case the voltage of the latter machine is considerably below normal.

Cost of Steam Leak Equaled Price of a Valve Each Month

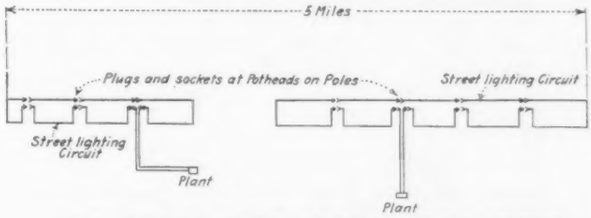
As a striking example of the speed with which steam leaks "run into money," Mr. E. J. Billings of St. Joseph, Mo., related the following incident at the recent convention of the Missouri Public Utilities Association. "Not long ago," said he, "while engaged in making power-house tests at a certain plant, I noted an open-ended 1-in. pipe leading down the side of one of the boilers. The valve on this line was leaking steam. It was not leaking badly, but nevertheless it was a very noticeable leak. Following a friendly argument with the engineer regarding the size of this leak, a pail of cold water which had been weighed previously was hung on the side of the boiler so that the end of the pipe projected into the water."

It was found that the bucket of water increased in weight at the rate of 14 lb. per hour, or 336 lb. per day, continued Mr. Billings. The cost of fuel to produce 336 lb. of steam at this plant was approximately 7 cents.

The actual money lost through this leak was therefore 7 cents a day, or $2.10 a month, or $25.20 a year. A new 1-in. globe valve of the very best type could have been purchased and installed for $2. A new valve on this line, assuming that the old valve was beyond repair, could therefore be purchased and installed at a price lower than the cost of allowing the steam leak to continue for one month. The leak was stopped.

Sectionalized Circuit for Series Tungsten Street Lighting

In five miles of tungsten lighting recently installed on Meridian Street at Indianapolis, Ind., there are seven places at which the circuit may be sectionalized in case of trouble. The 410 gas-filled tungsten lamps in this installation are operating in cast-iron ornamental standards and receive energy from underground cir-



A SECTIONALIZED SERIES STREET-LIGHTING CIRCUIT

cuits. At street intersections where overhead lines cross the boulevard lighting system, however, the underground series circuits have been run through conduit and cable to the top of the cross-lead poles. There in the series circuit interchangeable potheads have been installed near enough to each other to permit a portion of the lighting line to be short-circuited upon itself in case of trouble, allowing the remainder of the line to be placed in operation free from the damaged portion of the circuit. A diagram illustrating the arrangement of these series circuits, which are fed from the plants of the Merchants' Heat & Light Company, is given in the accompanying illustration.

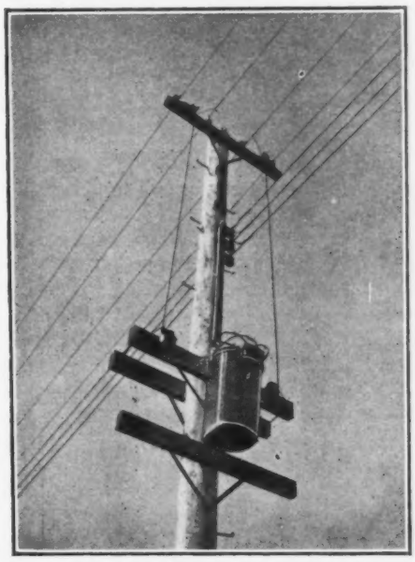
A Handy Tool-Delivery Wagon

The handy small-wagon outfit shown in the accompanying illustration consists of a two-wheeled pushcart attached to the frame of a bicycle. It is used by George A. Bankert, city electrician of Del Norte, Col., for conveying his electrical material, tools, etc., to and from jobs. He says the outfit has been found to be "just the thing" for meter work. On a smooth, level roadway a man can easily pull a 100-lb load in the cart.

GOING TO A WIRING JOB WITH NECESSARY TOOLS

Fiber Conduit Used in Transformer Installations

Secondary leads from transformers to the secondary distribution circuits of the Union Electric Company of Dubuque, Ia., are inclosed in fiber conduit. In pole-type transformer installations both neatness and safety are gained by this type of construction.



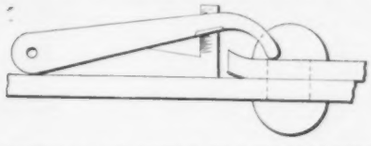
TYPICAL TRANSFORMER POLE AT DUBUQUE

With the more common type of open wire construction the leads sag in time and become disarranged through contact with men climbing the poles, even though care may be exercised at the time of the original installation to make square turns in all leads and otherwise to enhance the appearance of transformer poles.

Inclosed leads in this scheme always remain in their original position. On poles where several circuits are carried the protection afforded by the fiber conduit is especially valuable.

Convenient Plate Calipers

In making appraisals and estimating the strength of material it is frequently necessary to measure accurately the thickness of plates which are in such positions that ordinary calipers cannot be used. In such cases an instrument similar to the one shown herewith can be easily made by a machinist and employed as indicated in the illustration. This device, which was developed by Mr. C. R. Summers, a representative of



METHOD OF USING PLATE CALIPERS

the Hartford Steam Boiler Inspection & Insurance Company, is particularly useful in measuring the thickness of boiler and tank plates which may be upset or deformed at the only exposed edges and otherwise measured with a steel rule.

Extracts and Abstracts

Metering of 10-Watt Loads

The use of the 10-watt lamp is continually growing, and it behooves the meter department of every small central station to see to it that watt-hour meters are adjusted to record accurately these 10-watt loads. This is the substance of a remark made by Mr. Roy Rohrbaugh of Sandusky, Ohio, before a recent meeting of meter men of the Ohio Electric Light Association. Further advice which Mr. Rohrbaugh offered to the small-plant men was that they should insist on meters being installed in positions accessible to testers; they should carry a liberal stock of spare meter parts; they should keep accurate records of the conditions of jewels in meters of high rating as a guide by which to tell how frequently to test, and they should, above all, own, maintain and use accurate meter-testing equipment.

Fuel Economy Increased 12 Per Cent with Economizers

The N. E. L. A. committee on prime movers in its recent report gives some interesting operating information concerning economizers as installed in the Fisk Street station of the Commonwealth Edison Company of Chicago. According to the report, each economizer has about 8500 sq. ft. of heating surface, or approximately 70 per cent of that in the boiler it serves. The gases entering the economizers are required to flow through three passes. The first has an area of 2573 sq. ft., the second 2833 sq. ft., and the third 3093 sq. ft. With gas and water-inlet temperatures of 600 deg. Fahr. and 98 deg. Fahr. respectively, the outlet temperatures will be 325 deg. Fahr. and 271 deg. Fahr. respectively. These conditions will exist when each boiler is evaporating 65,000 lb. of water per hour and maintaining a normal pressure of 210 lb. At this and lower rates of evaporation with the feed water furnished at 94 deg.

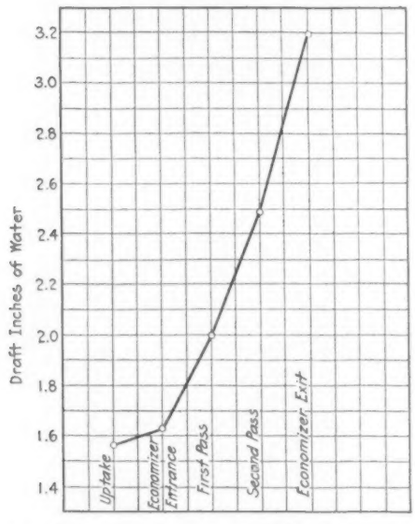


FIG. 1—DRAFT PRESSURE IN ECONOMIZER PASSES

Fahr., the reductions in flue-gas temperature are as shown in Fig. 2.

From these curves, which are plotted with actual performance data, it can be seen that gas-exit temperatures almost as low as 230 deg. Fahr. can be obtained when only 40,000 lb. of water is evaporated per hour. The increase in economy afforded by these economizers is from 10 to 12 per cent. If the feed water could be supplied to the boilers at the temperature corresponding to the steam pressure, however, it would mean a further gain of about 6 per cent. But the cost of accomplishing this must be more than offset by the gain in economy to warrant installing required equipment.

To maintain the proper heat transfer in these economizers, they have been designed with gradually decreasing gas-flue cross-sections from the inlet to the outlet so that the velocity of the gases is held constant throughout. Induced-draft fans rated at 80,000 cu. ft.

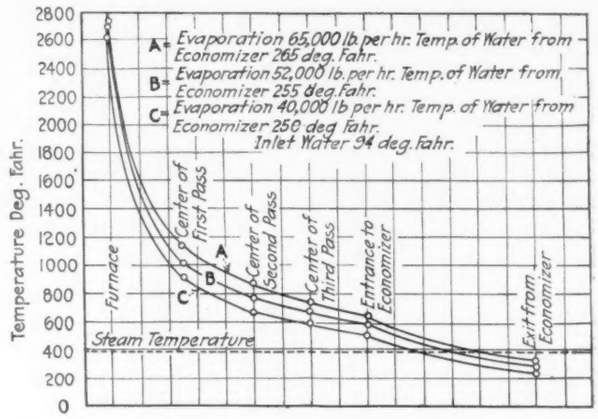


FIG. 2—BOILER AND ECONOMIZER TEMPERATURE DROPS

per minute are employed in the gas passage to maintain a draft of 1.5 in. of air in the boiler uptake. This makes the pressure in the economizer exit about 3 in., so that leaks, if allowed to develop, may seriously affect the economy of operation. Each economizer consists of 528 12-ft. tubes staggered. The apparatus was furnished by B. F. Sturtevant & Company.

Two Extremes in Distribution-Line Loss

The data secured from inquiries made by the Engineering Experiment Station at Ames, Ia., to ascertain what distribution losses central-station companies in the State were experiencing show one of the lowest records credited to a town of 500 population. Here alternating current is distributed at 220/110 volts from a substation and a three-wire system. On account of the good line construction and the absence of service transformers, 23,000 kw-hr. of the 25,000 kw-hr. taken from the substation in 1913 was actually delivered to the consumers. These data indicate a loss of only 8 per cent and are remarkably low in view of the light load carried at times and the fact that twenty-four-hour service was rendered.

The other extreme in line loss came from a smaller town also served by a substation. In this town about thirty service transformers were used to supply energy to about sixty customers' connections. During one month of twenty-four-hour service the energy registered by consumers' meters was 40 per cent less than that purchased at the substation. The core loss and other losses were entirely out of proportion to the peak load provided for.

Why It Pays to Watch Turbine Water Rates

There is a point in the gradually increasing water rate of turbines due to defective or worn blading at which it will pay to make the necessary repairs to bring the steam consumption of the unit back to normal. Consider, for example, a 5000-kw turbine having a water rate of 15 lb. per kw-hr., not including the turbine auxiliaries. This machine might generate in twenty-four hours an average of perhaps 50,000 kw-hr. With the

fuel cost of producing steam at 20 cents per 1000 lb., the cost for fuel alone for this turbine would be $150 a day, or $4,500 a month. Defective or worn blades might increase the water rate of the turbine from 15 lb. to 16 lb. per kw-hr., which would mean an increase in fuel consumption of 6.7 per cent. Such an increase would mean an actual additional expenditure for fuel of around $300 a month, or $3,600 a year. If the water rate of this turbine continued to increase and reached 17 lb. per kw-hr., the additional cost of fuel would reach $7,200 per year. At a rate of 18 lb. per kw-hr. the additional cost would be $10,800 a year.

At some point along this line of increase it will certainly pay to overhaul the machine to make it operate at normal efficiency. Local conditions make each case a separate problem, but, as stated by Mr. E. J. Billings before the Missouri Public Utilities Association, the problem is one which should not be settled by snap judgment, but by carefully weighing the possible saving against the cost of making the repairs.

Gas-Filled Street Lamps Please Dubuque Public

In March, 1914, the Union Electric Company, of Dubuque, Ia., was operating 470 6.6-amp series, alternating-current street lamps which consumed 75,000 kw-hr. monthly, said Mr. E. W. Walker, general manager of the Union company, before the Keokuk convention of the Iowa Section of the National Electric Light Association. In March, 1915, with 585 600-cp and thirty-four 400-cp gas-filled tungsten lamps replacing the arc lamps, only 59,000 kw-hr. was consumed, despite the increased number of street lamps. These new lamps have been operated on an all-night, every-night schedule since September and October, and the renewals—exclusive of lamps which failed within a few hours of installation owing to defects—have totaled only ninety-five 600-cp units and one 400-cp unit. Many of the original lamps, which are still in service, show life records well above 2000 hours; in fact, the average life of all the lamps is now approximating that figure. The lamps which have been operating longest, continued Mr. Walker, show a diminution in intensity, but the light from them is still superior to that furnished by the old arc lamps.

The item of outages, for which the Union Electric Company has had to pay under its contract with the city, has incidentally been reduced from 0.42 per cent of the total amount of the bill to 0.15 per cent of the total. The improved street-lighting service has, according to Mr. Walker, been highly satisfactory to the people of Dubuque.

Safety—Service—Success

The employees of the Duquesne Light Company, Pittsburgh, Pa., received the following message from President James D. Callery in the May issue of the *News:*

"No man ever achieved success without ideals to guide him. Safety and service should be included in any list you may have adopted. The careless man is never the most efficient man. Service is the basis upon which depends compensation. The public demands greater safety and still more efficient service. The Duquesne Light Company seeks to serve the public satisfactorily. You are an important human unit of the company. Keep safety to yourself and others constantly in mind. Better service to your company means better service for the public. Co-operation and efficiency ultimately will bring maximum safety and service, and therefore success."

Questions and Answers

Alternating-Current Elevator Motors

Have alternating current motors been found suitable for passenger elevators? W. J. R.

Alternating-current elevator installations are growing in favor. One manufacturer reports that the alternating-current sales represent about one-third of the total. In one Southern city the installation of alternating-current elevator equipment has helped in the solicitation of hotel and office-building service owing to distribution conditions.

Power-Factor of Gas-Filled Tungsten Lamps

What is the power-factor of the coiled-filament, gas-filled tungsten lamps which are now being manufactured? M. F. W.

The power-factor of the new incandescent lamps is approximately unity. Engineers from the laboratory of the National Lamp Works of the General Electric Company have stated that the power-factor of the new lamps is 99.9999 per cent. For all practical purposes, therefore, the coiled-filament lamps may be said to operate at the same power-factor as the common straight-wire filament lamps.

Selecting Indicator Spring

Is there any fixed rule as to just what scale of spring should be used in the indicator for a given case? What spring ought I to use in indicating a steam engine if the boiler pressure is 105 lb.? L. L. R.

It is customary to select a spring of such weight that the height of the indicator card will not exceed about 2 in. To produce a card 2 in. high with a boiler pressure of 105 lb., the spring would have to be $105 \div 2 = 52.5$ lb. In the indicator kit the springs are ordinarily numbered 20, 40, 60, 80 and 100. The number next above 52.5 is 60, so a 60 spring would be used. This would give a card with a height of not more than $105 \div 60 = 1\frac{3}{4}$ in.

Overloading of Steam Boiler

How is it possible to determine when a steam boiler is overloaded? K. R. V.

Every steam boiler is designed for a certain output under normal conditions, and this is known as the rated horse-power. If the rate of firing is increased, and consequently the rate of evaporation, so that the horse-power developed is greater than the rated horse-power, the boiler is said to be overloaded, or working under an overload. The amount of overload is usually expressed as a percentage of the rated horse-power. For example, if a 200-hp boiler is operating under a 30 per cent overload, the boiler is developing $200 + (200 \times 0.30) = 260$ hp.

Operating Oil-Burning Plants at Light Loads

Is it true that ordinary oil burners will not permit of operating boilers so equipped at very light loads? L. E. N.

Experiments conducted at the Pacific Gas & Electric Company's steam standby plant in San Francisco have shown that the smallest quantity of oil that can be burned with an oil burner of the size in use is about 280 lb. per hour. If it be attempted to burn oil at less than this rate, the fire will go out. To insure good combustion and uniform distribution of heat, it is advisable to operate with not fewer than two burners; consequently each boiler will generate over 200 hp, or about 27 per cent of the rated load, if a fire is kept under it

continuously. It is therefore essential to keep a number of boilers standing by, with steam up but with the fires out, whenever the load on the station is very small in proportion to the load the station is expected to pick up in case of emergency.

Expansion of Pipes

Give some simple rule for determining the approximate change in length of pipes after steam is admitted. B. T.

To compute the change in length of a pipe when steam is admitted, the following formula can be employed: Expansion in inches $= C(T_s - T_a)L$, where C is the coefficient of expansion for the metal, T_s is the temperature of the steam in degrees Fahrenheit as obtained by adding the superheat temperature to the value found opposite the pressure in steam tables, T_a is the temperature of the air, and L is the length of the pipe in inches. For most practical purposes C can be assumed to be 1/150,000 in round numbers. Expressed in other terms, a cast-iron pipe will expand about 0.75 in. and a wrought-steel pipe about 0.82 in. for each 100 ft. of length with every rise in temperature of 100 deg. Fahr., if the pipe is well covered. A further discussion of expansion in steam pipes will be found in the ELECTRICAL WORLD of April 10, page 926.

Lighting of Motion-Picture Theaters

What kind of lighting equipment can be used in a motion-picture theater where bright illumination is desired during changing of films and faint illumination is required during exhibition of pictures? The ceiling is 20 ft. high and the floor 35 ft. wide and 90 ft. long. E. M.

To avoid fatiguing the eyes of the audience it is advisable to illuminate theaters with semi-indirect, indirect or concealed lighting units. It is especially important that the light furnished during the exhibition of pictures be faint and diffused, otherwise the pictures will be indistinct. This effect is caused not so much by the light cast on the screen as by the contraction of the pupils which takes place when light sources are in the line of sight. Satisfactory illumination is furnished in one theater known to us by direct-indirect lighting units arranged in two rows along the ceiling over each bank of seats. During change of films the direct diffused light from the bowls is employed while during picture exhibition only faint indirect light is furnished. The reflected light can be toned in color by tinting the ceiling, using color filters or dipped bulbs. In some theaters bracket fixtures are employed, the light during picture display being furnished by lamps inclosed in reddish-brown or buff-colored diffusers. The latter method of illumination does not appear to be so satisfactory as the first-mentioned, since only the outside aisles are illuminated during performances and the light sources are tiring to the eyes of those seated near them.

Changing Quality of Steam by Reducing Valve

Kindly explain how it is possible to change wet steam to dry saturated steam or even to superheated steam by passing it through a reducing valve. A. L. J.

When steam is allowed to flow through a reducing valve it is throttled; that is, its pressure is reduced. Before passing through the valve each pound of steam has a certain quantity of heat, depending on its condition as to pressure and dryness. After passing through the valve, each pound of steam still has the same amount of heat, neglecting the slight radiation from the valve. For the expansion of the steam from the high pressure to the low pressure is a free expansion and is performed without the conversion of any heat into work. Now reference to the steam table will show that the heat contained in a pound of saturated steam at a high pressure is greater than that at a low pressure. As no heat is lost in the reducing operation, the difference of the total heats at the two pressures represents the amount of heat made available for drying or superheating the steam at the lower pressure. To illustrate, suppose that the steam entering the reducing valve is dry and saturated, at a pressure of 120 lb. absolute, and that it is reduced to a pressure of 80 lb. absolute. A pound of saturated steam at 120 lb. absolute contains 1189.6 lb. Fahr. heat units, and at 80 lb. absolute it contains 1182.3 lb. Fahr. heat units. The difference, or 1189.6 — 1182.3 = 7.3 lb. Fahr. heat units, is the amount of heat possessed by each pound of the steam at the lower pressure in excess of that required to maintain it in a dry saturated state. This excess, therefore, serves to superheat the low-pressure steam. Taking the specific heat of superheated steam as 0.48, the superheating amounts to approximately 15 deg. Fahr. Hence the effect of the reducing valve is to change dry saturated steam at 120 lb. absolute to steam at 80 lb. absolute with 15 deg. of superheat.

Causes and Prevention of Water Hammer

What produces water hammer in steam pipes and how can it be prevented? T. V. W.

Water hammer in steam pipes is caused by water being suddenly projected at excessively high velocity against some turn or valve in the pipe. The water may have been carried directly from the boilers with the steam or it may have come from depressions or pockets where condensate had collected. Many times abnormal conditions have been caused by repair work being done without suitable supervision. One case of water hammer has been reported where a repair man placed the feed-water inlet too close to the steam outlet. The trouble was stopped by changing the position of the feed-water pipe. Priming of the boiler and sudden demands for steam often cause water to be thrown into the steam main. The last cause which produces violent ebullition may be prevented if valves are opened slowly. Priming is usually caused by impurities in the boiler water. Many of these can be removed or converted into harmless forms by mechanical or chemical means. The kind of water softener which should be used can be determined from an analysis of the boiler-feed water. Care should be taken not to use too much boiler compound or the wrong kind, as it may augment priming. Where spray cannot be prevented in the steam dome, baffles can be employed to separate the water and steam. Improperly arranged pipes and valves often cause water hammer. If pockets are formed below the drainage level of pipe lines, they may collect water and condensate, which if caught by passing steam may produce water hammer. Steam pipes and valves should be installed so that if steam does condense on the walls it will flow readily into drains. This can be done by sloping pipes away from valves and taking steam out of the upper side of headers. If a valve does have to be placed so that water may collect above it when closed, a pipe should be connected with the pocket so it can be drained. Reducing fittings on horizontal runs is often responsible for water pockets. Water hammer may also be caused if steam is turned into a cold main too rapidly, as condensation will take place at an abnormal rate. Pipes should be allowed to warm up before steam is permitted to flow through them at high velocity. Properly lagging steam pipes and superheating the steam will also assist in preventing water hammer by minimizing the amount of condensate that will form.

COMMERCIAL SECTION

SECRETS OF SUCCESSFUL MERCHANDISING

The Methods Employed by a Contracting and Merchandising Firm in the Middle West, and Its Underlying Policy of Preparedness

"You have got to keep it in stock!"

These words represent the sum and substance of the advice which Mr. W. J. Ball, president of the Illinois Electrical Contractors' Association and manager of the Tri-City Electric Company at Moline and Rock Island, Ill., and Davenport, Ia., gives to those who seek the keynote of success in electrical merchandising.

"Stock," he insists, "is essential if the local electrical store wishes to get the trade of the manufacturing plants, the isolated power stations, the big business houses, the homes, and, in fact, all of the really 'worthwhile' business in a city.

"Find out what the buyers in your town need. Find out what they order from the electrical catalogs. Then put in a stock of those materials and appliances and inform the prospective customers impressively that you can meet their needs at reasonable prices and can make deliveries that are instantaneous. Spare no effort to create and leave a strong impression that you really carry a *stock* of things these buyers need. There is the inner secret of successful merchandising—to stock the goods and let the people know.

"The time will soon come when they will want something electrical in a hurry, and they will ask you if you have it in stock. With that one sale made on quick delivery, the road is open to future business of greater volume."

Just to show that he himself believes in these precepts and has built his own successful business on these lines, Mr. Ball takes the interested visitor through the spacious building of the Tri-City Electric Company at Moline and demonstrates that when he says stock he means stock. Entering the store and standing in the customers' area, neatly arranged stock in broken package lots may be seen on rows of well-placed shelves. Washing machines, vacuum cleaners and electric ranges are placed where they may be inspected and handled by

FIG. 2—THE FIXTURE DEMONSTRATION ROOM

all patrons without clogging the available floor space. Passing down the long carpeted aisle between the clerical offices and the rows of steel shelves with demountable bins, more stock—lamps, switches, sockets, bolts, nuts, batteries and what not—is within easy reach of salesmen and within view of those who pass that way to the fixture room or the motor-repair department in the rear. The fixture room is well provided, carefully

FIG. 1—SHELVES WELL FILLED WITH STOCK GREET THE PROSPECTIVE CUSTOMER AS HE ENTERS THIS STORE

wired, tastefully appointed, and adequately equipped with comfortable tapestry-upholstered chairs for women customers. Ordinarily this long, narrow room is dark, but when fixtures are to be displayed by operating wall switches placed conveniently near the door it can be lighted up with the fixtures to be demonstrated. Many makes and types of portable lamps and hanging fixtures are kept in stock.

In the rear of the store, where auxiliary access to the side street and an alley is available, is the motor shop and repair department, which, Mr. Ball says, is not only a profitable part of the business but is also a money saver for motor and electrical appliance users in the Tri-Cities and their tributary territory. Breakdowns of every character are repaired here, saving the owners of the equipment neat sums in freight charges and the many tedious days of delay which somehow always seem to accompany the process of "sending a machine back to the factory."

Catalog File Backs Up a Well-Selected Stock

Of course, there are calls now and then for unusual devices and appliances which the stock does not con-

FIG. 3—THE TRI-CITY ELECTRIC COMPANY'S BIG BUILDING, WITH ITS BASEMENT FULL OF STOCK

tain, for no local electrical store can expect to carry everything that anyone might seek. So this policy of preparedness is carried further, and an exceedingly well-maintained catalog file, indexed and cross-indexed, is provided for such cases. If a salesman, forced to admit that he cannot immediately supply the customer's wants, can quickly place before the prospective buyer an illustrated catalog showing the very device in question there is still hope of making a sale. The catalog file of the Tri-City Electric Company is used in this way. It can be successfully used in this way only because it is always maintained in up-to-the-minute completeness. Any catalog file is worth only what its owner makes it worth, and the Tri-City company, realizing this fact, has not hesitated to have one of its most competent employees, an engineer, devote whatever time is necessary to scanning the electrical periodicals and to getting literature on all electrical equipment. And the effort and investment centered in this catalog file have been well repaid by new customers and directly traceable business secured through the influence of this readiness to serve.

For serving the old customers, those who have had their buildings wired by workmen of the Tri-City company and have always traded at the store, another system is maintained. It is a blueprint file. The working drawings which have been used on a contract job and carry all notations and changes from original plans are kept, so that when in the future wiring extensions are desired engineers of the contracting company know just what has been done and can quote promptly and accurately on the additional business.

Usually the filing of rolled and used drawings is a thing to be avoided, but the Tri-City company employs

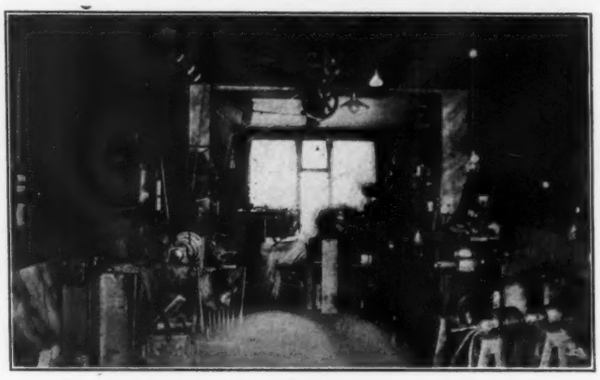


FIG. 4—THIS MOTOR REPAIR SHOP DOES HELPFUL WORK FOR MANY APPARATUS OWNERS

a cardboard can about 3 in. in diameter for the prints of each job or each group of jobs. After standardizing on three lengths of cans, it has been found that this blueprint-filing system meets admirably the needs of the company and is a time and money saver. According to Mr. Ball it is the only successful system for filing prints which have been rolled and have been used by construction forces because it is almost impossible to restraighten a rolled print, and it has proved itself well worth while in Moline. It is just another bit of preparation that makes for better service.

Salesmen of the Tri-City Electric Company do not all spend their time in the store, however. As evidence of this it may be mentioned that the company has already disposed of about 1000 Franz Premier electric vacuum cleaners in the territory which it serves, and outside salesmen were largely responsible for securing this business. To aid these solicitors the company, of course, offered special inducements to the public.

FIG. 5—THE CLERICAL OFFICES AND THE AISLE ADMITTING TO THE ROWS OF STEEL SHELVES

In one of these offers the company agreed to allow each purchaser $2 as the "trade-in" value of any type of sweeper he might possess. As a result of this offer, sweepers of every description, from the old hand-power carpet sweeper to gasoline-engine-driven suction cleaners were brought to the company's repair shop. All

that were worth saving were repaired, cleaned up and resold at prices which on the average nearly returned the $2 discount to the Tri-City company. In another special selling plan the company offered to rent a vacuum cleaner for two weeks for $2. In case the renter wished to keep the machine at the end of that period the two-dollar rental charge could be applied on the purchase price. Of the many who rented machines, very few returned them to the company.

In short, the Tri-City company is engaged in the business of selling the public every kind of merchandise and service that comes within the scope of things electrical, and the keynote of its whole activity is preparation, the effort to anticipate the opportunity in order both to serve the customer better and to conserve the time and labor involved in doing business. The details of accounting as practised by this organization follow closely the system authorized and advocated by the National Electrical Contractors' Association, but here and there new "kinks" have been introduced to eliminate further loss of time and danger of accident.

One point of particular interest is the rearrangement of the "reminders" on the estimate sheet from which every job is figured. This rearrangement places the items in such order that prices and discounts may be looked up in groups and the necessity of referring to a price list or discount sheet more than once for each estimate is eliminated.

The items are arranged in the following order:

Conduit,	Knife switches,	Locknuts,
Conduit elbows,	Branch cut-outs,	Connectors,
Conduit couplings,	Panel cut-outs,	Bells,
Rubber-covered wire,	Power panels,	Buzzers,
Lead-covered wire,	Light panels,	Push-buttons,
Special wire,	Main cabinets,	Bell transformers,
Flexible conduit,	Cut-out cabinets,	Batteries,
Armored conductors,	Special cabinets,	Annunciators,
Loom,	Sockets,	Bell wire,
Ceiling boxes,	Receptacles,	Telephones,
Bracket boxes,	Shade holders,	Telephone cable,
Switch boxes,	Shades,	Plug fuses,
Box covers,	Lamp cord,	Cartridge fuses,
Floor boxes,	Reinforced cord,	Speaking tubes,
Flush receptacles,	Cleats,	Nails,
Flush switches,	Knobs,	Screws,
Snap switches,	Tubes,	Toggles,
Pendent switches,	Rosettes,	Bolts,
Main switches and cut-outs,	Fixture studs,	Tape,
	Bushings,	Solder,

"But stock is the basis of it all," reiterates Mr. Ball, as he closes every conversation on this subject. "Stock in plentiful and well-selected quantities is an absolute essential to the successful merchant of electrical goods."

The officers of the Tri-City Electric Company are: President, Mr. W. T. Ball; vice-president, Mr. E. M. Kunkle; secretary and manager, Mr. W. J. Ball; treasurer, Mr. I. N. Butterworth.

The Employee's Personal Influence

How strong is the personal influence of every employee of a central station was graphically illustrated by Mr. Robert Montgomery, manager of the commercial department of the Louisville Gas & Electric Company, in an address before the Employees' Club. Mr. Montgomery stated that an average of three inquiries a day are received by the commercial department as a direct result of some bit of business boosting on the part of the vice-president and general manager of the company, Mr. Donald McDonald. People are always coming into the office, he said, and introducing themselves by remarking, "I was talking to Mr. McDonald the other day, and he told me ——" The inquiries relate to almost every character of service. If each of the 500 employees of the company were as active as Mr. McDonald, Mr. Montgomery pointed out, there would be 1500 inquiries a day and the commercial department would have to be very largely extended to take care of the business.

The influence of word-of-mouth recommendation, Mr. Montgomery said, is stronger than any other kind of advertising, and to illustrate his point he remarked that if any of his hearers saw in a newspaper that the greatest act ever staged was coming to the local theater the impression would not necessarily be compelling, while if such a person met a friend who had seen the same act in Cincinnati and told him that it was too good to miss the hearer would probably lose no time getting tickets.

Gas-Filled Units for New York Street Lighting

During the last six months the illumination of New York City's streets has undergone a thorough change. Gas-filled tungsten lamps in various sizes have been substituted for the former arc equipment and have also been used for new and additional lighting. Upward of 10,000 inclosed carbon and flaming-arc lamps have been

FIFTH AVENUE, NEW YORK CITY, NOW LIGHTED BY TWIN 400-WATT GAS-FILLED TUNGSTEN UNITS

replaced by an equal number of gas-filled tungsten lamps in the 300, 400, 500, 750 and 1000-watt multiple types and the 400-cp series type.

While this substitution was made on a lamp-for-lamp basis the size in each case was determined by the illumination demands of the immediate vicinity, as follows: Large squares at intersecting streets and junction points, 750-watt lamps; important thoroughfares, 500-watt lamps; crosstown thoroughfares like Thirty-fourth, Forty-second and Fifty-ninth Streets, tree-lined or parked avenues, and streets and avenues with car lines, 400-watt lamps; mercantile and wholesale districts, residence streets and small parks, 300-watt lamps.

Approximately 600 multiple-arc lamps in use on the bridges connecting the several boroughs have also been replaced by 300-watt gas-filled tungsten lamps. These lamps are divided between those of the bowl-frosted type, installed with socket housings having an elongated neck reflector coming well down over the neck of the lamp and without the usual globe inclosure, and those in standard housings. The lamps operating without inclosing globes are of the straight-sided, pear-shaped type and have withstood local climatic conditions and traffic vibrations satisfactorily.

ADVANCING "THE COMMERCIAL PURPOSE"

Details of the Selling Work Carried on in North Yakima, Wash.

An interesting story comes from North Yakima, Wash., of a salesman of the Pacific Power & Light Company who saw a farmer driving along one day with a gas engine in his wagon. The salesman trailed the farmer home and found that his farm was situated well within reach of the company's lines, whereupon he opened fire and sold a 3-hp motor to do the work for which the gas engine had been purchased. The engine was never taken from the wagon. It illustrates well the spirit of the selling that is making such notable successes among the Far Western cities.

One Customer for Every Five Inhabitants

North Yakima is a city of 17,000 population, and 3400 electric customers are connected to the lines, more than would be considered possible by the usual calculations based on general experience. Among these 3400 customers 2500 electric irons are in use, yet a recent campaign that offered an iron for $3.50 with an ironing board and stand included as a special premium resulted in the sale of 100 flatirons more. About 50 vacuum cleaners and 100 other appliances were disposed of in another campaign which offered a cleaner and two other appliances of a total value of $50 at an "easy-payment" bargain price of $39. At the moment another campaign is being made for the sale of washing machines by loading two "workers" into a wagon and calling from house to house on rural customers, demonstrating a ninety-dollar machine and a fifty-dollar machine at each house.

Mr. George C. Sawyer, local manager in North Yakima, endeavors "to make the commercial purpose the dominating influence in every activity of the company," and to utilize all contact between his employees and the public to better the good feeling toward the company and increase the popularity of electric service.

He had occasion to make a hurried house-to-house canvass recently to secure certain statistical data, and while the time allowed for the work was short and permitted only a brief call at each home, the opportunity was taken advantage of and the customers questioned as to the satisfaction derived from their appliances, and suggestions were made as to other appliances that would be advantageous to them. The results are naturally indefinite, but a direct personal suggestion of this kind is valuable and the idea will undoubtedly bear fruit. The customer feels pleased at the attention he receives.

Free Repairs of Customers' Appliances

Not long ago Mr. Sawyer decided that there were many appliances that were not in use because of minor troubles, therefore he sent out "inserts" with the bills, offering to repair such appliances free of charge. In a period of one month about fifty appliances were repaired under this offer, a great majority being small repairs handled at small expense.

In the rural districts applications for lighting service necessitating short extensions that would be very unprofitable for straight lighting business are frequently received. In these cases the salesman attempts to place a 1-hp or 2-hp motor for pumping water for domestic and stock purposes, operating cream separators, washing machines and similar tasks. If the customer is so situated that it can be used to advantage, the salesman endeavors to place an electric range in this way, and though the customer may be anxious for light only and not especially enthusiastic over the range or motor, frequently the salesman succeeds in securing the business and, after the appliances are installed, they soon breed the additional enthusiasm that was lacking at first. Meter readers in the rural districts are an important factor, too, in helping to boost the sale of appliances. Owing to the long distance from town at which some of these North Yakima customers live, a very capable man is sent to read these meters, one who can advise the customer regarding motor and pump troubles.

Each year the Washington State Fair is held at North Yakima, and the Pacific Power & Light Company usually exhibits an electric tent demonstrating all kinds of machines and appliances. A record is kept of all inquiries, and these are followed up carefully immediately after the fair. At the last exhibition names were taken of people residing in all parts of the State who were visiting the fair. Letters were then written to the electrical companies operating in these towns, giving the names and addresses of the interested parties and mentioning the appliances they were interested in. While this procedure returns no revenue to the company directly, it helps the other fellow in the spirit of co-operation.

In the past fifteen months appliance sales in North Yakima have run as follows: Irons, 648; toaster stoves, 113; disk stoves, 31; fans, 100; toasters, 96; washing machines, 36; motors, 63; ceiling fans, 12; vacuum cleaners, 88; percolators, 56; heating pads, 27; electric heaters, 16, and 43 other appliances, making a total of 1329 appliances, while 20 electric signs were sold on the instalment basis.

Shifting the Burden of Securing Right-of-Way

One of the expenses incident to the building of electric-service lines into new and sparsely settled communities is that of securing easements and rights-of-way. Particularly in unincorporated territory do utility companies find that landowners ask unreasonable prices for their concessions which greatly increase the cost of the line. Even the cost of sending a man out to secure easements given gratis adds to the expense chargeable to a new line. But if the burden of securing these easements can be shifted to the person or persons who originally make application for service, the utility company not only secures its right-of-way absolutely without cost, but it can obtain a considerable quantity of favorable publicity, since a property owner naturally respects the statements of his neighbors more readily than those of the unknown representative of a corporation. Mr. R. B. Snyder, sales manager of the Milwaukee Electric Railway & Light Company, has tried this plan with success several times when lines were to be built to outlying districts, and the saving resulting makes the scheme seem well worth while.

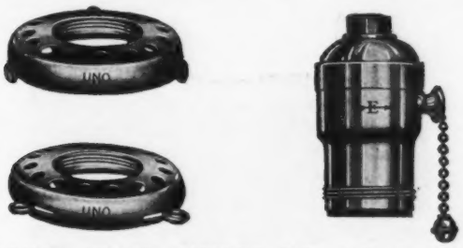
Refrigeration in Silk Dyeing

There is hardly any art that cannot be advanced somewhat by the aid of electricity. The Philadelphia Electric Company has in the past year made a number of electrical refrigeration installations, of which, perhaps, the most interesting are those used in connection with silk dyeing. Formerly the dyeing of silk was subject to large losses. Annually millions of dollars' worth of fine silks have been damaged in the dyeing. It was discovered after a long study that the damage was due to changes in temperature causing a precipitation of crystallized tin salts which cut the fibers and allowed the silken strands to fall apart. The dyeing establishments are now able, however, by the use of artificial refrigeration to secure practically a constant temperature in both the bath and the washing water, thereby eliminating almost all of the former trouble from this cause. The Philadelphia Electric Company now has two silk mills on its lines using electrical refrigeration.

NEW APPARATUS AND APPLIANCES

One-Piece Shade Holders

In the accompanying illustrations are shown two one-piece shade holders, one of which is equipped with screws and the other with a spring for supporting the shade. The shade holders are designed to be attached to brass-

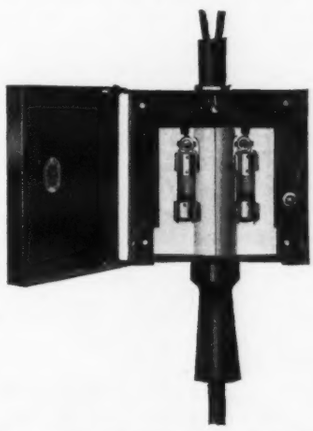


ONE-PIECE SHADE HOLDERS FOR ATTACHING TO BRASS-SHELL SOCKETS AND RECEPTACLES

shell sockets and receptacles provided with threaded beads, as shown in the illustrations. The "Uno" shade-holder, as it is called, is generally finished in old or brush brass. The shade holders are being placed on the market by the Arrow Electric Company, Hartford, Conn.

Fused-Plug Receptacle

A fused receptacle designed for use with portable units in industrial plants is being made by the Detroit Fuse & Manufacturing Company, Detroit, Mich. The receptacle is of No. 16 gage sheet steel with corners electrically welded. The fuses and terminals are mounted on two pieces of porcelain, held in place within the box by a steel wedge at the side. In case of accident or breakage the porcelain pieces may be easily removed and quickly replaced. The end plate at the bottom of the receptacle is also separate and removable. The receptacle may be equipped with fuses for any portable unit with rating up to 30 amp at 250 volts. After being provided with the proper type of fuses the receptacle may be sealed shut. All electrical terminals and contacts are thoroughly inclosed. In case of emergency when the controlling switch is at a distance, the circuit may be quickly opened by pulling the plug. The plug



INTERIOR VIEW OF FUSED-PLUG RECEPTACLE

is of the polarity type, rounded on one side and so shaped that it is impossible to reverse it when inserting it in the receptacle. It is of hard wood fitted with copper plates which make contact with terminals attached to the porcelain pieces within the receptacle. The cable passes through the center of the plug and is fastened to terminals at either side of the plug by means of contact screws. Worn cable may be easily and quickly removed and new cable inserted and attached.

Outdoor Switch Houses

Outdoor switch houses for mounting on poles, walls or towers, or on the ground, as shown in Figs. 1 and 2 respectively, have recently been developed by the West-

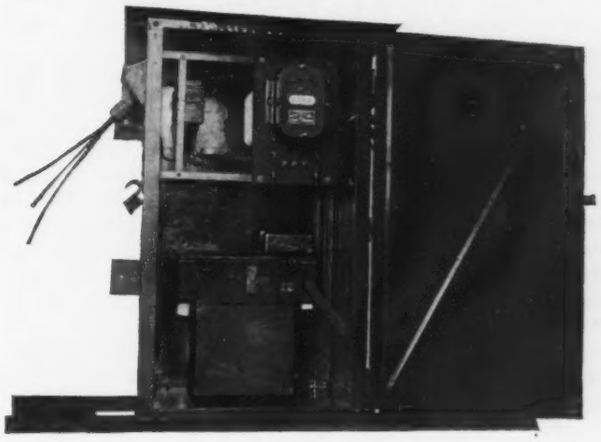


FIG. 1—SWITCH HOUSE FOR POLE MOUNTING

inghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The housing of both types is of sheet

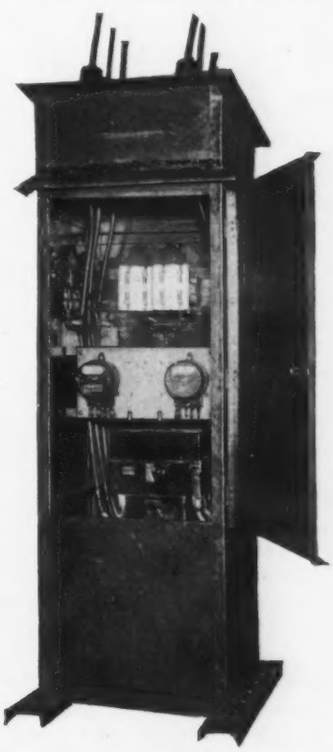


FIG. 2—SWITCH HOUSE FOR MOUNTING ON GROUND

steel built up on a structural-steel framework with a large door in front to permit ready access to the apparatus. All apparatus contained within the switch-house is accessible from the front.

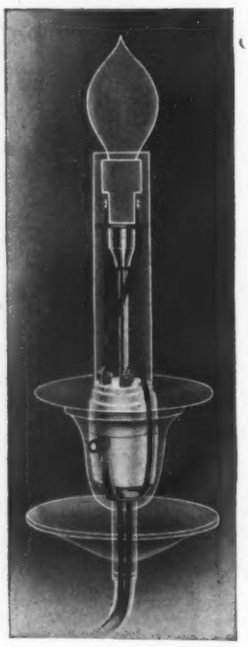
The switching equipment consists of a full-automatic,

self-contained, series-trip oil circuit-breaker mounted directly on the steel framework of the house. The manufacturer claims that by eliminating a slate panel for the circuit-breaker it has been possible to decrease the depth of the house by about 18 in. over that which would be required if the circuit-breaker were mounted on a panel, and that a door in the rear of the house has been made unnecessary. The metering equipment consists of a standard house-type polyphase watt-hour meter together with the necessary current and voltage transformers, fuse blocks and fuses. The meter is mounted on a small slate panel, on which are also placed the necessary current and voltage terminals provided for the connection of the operating company's testing and calibrating meters. In the house illustrated in Fig. 2 two single-phase watt-hour meters are used in place of a polyphase watt-hour meter.

The voltage transformers are mounted in such a way, it is declared, that accidental contact is impossible. The inlet and outlet bushings are also placed high enough to prevent contact with incoming or outgoing leads. The switch house shown in Fig. 1 can be mounted on hanger irons in the same manner as a transformer. The switch house is also adapted for mounting on a wall in proximity to the apparatus controlled. It weighs about 600 lb. The houses are shipped completely wired and equipped for service, with the exception of mounting the watt-hour meter and filling the circuit-breaker tanks with oil. Apparatus of both types with ratings up to 300 amp at 2200 volts and 4500 volts are being made.

Improved Candelabra Switch

The candelabra switch shown in the accompanying illustration has recently been redesigned and improved by the maker, the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Steel dowel pins are employed to insure perfect alignment of the two parts of the porcelain body. The supporting spider at the bottom of the device is so designed that the switch is held



CANDELABRA SWITCH

firmly to the fixture. Stems 3 in., 4 in. or 5 in. long can be provided, and the small indicating push-buttons are made in lengths suitable for cups of various diameters. The switch is of neat design and is well suited for fixtures where pull chains or projecting keys are not desired.

Third-Rail Insulator

In the accompanying illustration is shown a third-rail insulator which is being placed on the market by the Ohio Brass Company, Mansfield, Ohio. The insu-

FIG. 1—THIRD-RAIL INSULATOR

lator is held in position by means of an iron-bar forging lagged to the tie. Across the bottom of the insulator are slots recessed at each end to provide clearance for

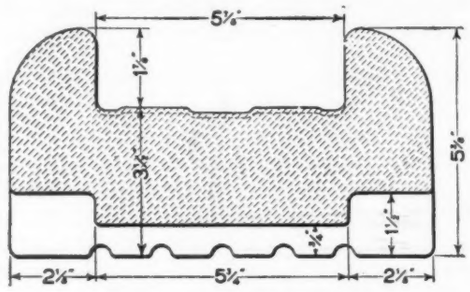


FIG. 2—SECTIONAL DIAGRAM OF INSULATOR

lagged screw-heads. The bar forging may be extended to provide a support for a protection board if desired.

Lighting Fixture for Shaving

A fixture with a mirror in front of the reflector and lamp, as shown in the accompanying illustration, has

SHAVING LAMP

been developed by A. B. Wilson, Leader Building, Cleveland, Ohio, for use in shaving and as a make-up lamp. The reflector is 8 in. wide by 3.25 in. deep, and the mir-

ror is 6.25 in. wide. The height over all is 12 in. An adjusting screw is provided for changing the position of the fixture. The "shavolite," as it is called, is finished in nickel.

Electric Compressor for Inflating Tires

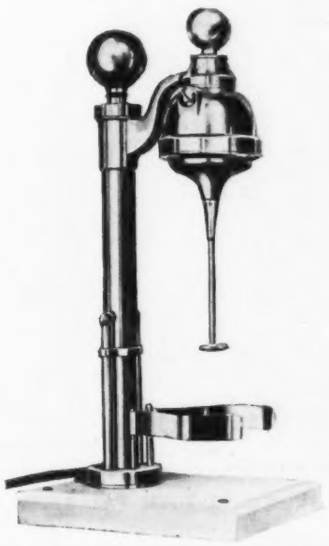
A portable motor-driven two-cylinder air compressor designed especially for use in garages for inflating automobile tires is shown herewith. It may be employed

PORTABLE ELECTRIC COMPRESSOR

as a pump for supplying air directly to the tires or for pumping air into a tank. Use is made of long pistons and no piston rings are employed. A small expansion chamber is provided for preventing oil getting into the air and injuring the tires. The compressor is operated by a 0.5-hp General Electric motor and is being made by the Hartford Machine Screw Company, Hartford, Conn.

Electrically Operated Drink Mixer

All parts of the motor-driven drink-mixing machine shown herewith are inclosed and waterproof, the manufacturer claims, and the working parts are provided with rounded corners and smooth surfaces. Lubrication is required at one point only, and the oil hole is closely sealed, making it impossible for gritty metal polish and sticky syrups to enter. The telescopic standard is round and the upper section fits over instead of



ELECTRIC DRINK-MIXING MACHINE

within the lower section, thus excluding wash water and syrups. The brush holders are mounted on the side and the renewal of carbons does not require the dismantling of the motor. All parts subject to hard wear are of monel metal. The cord is waterproof up to the connector. Rubber feet are provided for the machine, and these can be renewed with an ordinary screwdriver. The mixer is being placed on the market by the Fulton-Bell Company, 105 West Fortieth Street, New York.

Improved Switchboard for Small Lighting Plant

In Fig. 1 is shown a switchboard developed by the Globe Electric Company, 195 Broadway, Milwaukee, Wis., for use with its 30-volt gasoline-engine-driven generating plant, which is illustrated in Fig. 2. The

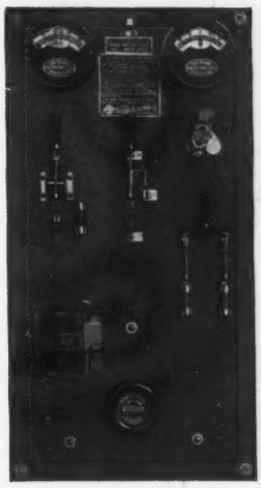


FIG. 1—SWITCHBOARD FOR SMALL GENERATING PLANT

switchboard is equipped with an indicating ammeter, a voltmeter, a switch to permit starting the engine by operating the generator as a motor, a device for reducing the voltage to the lamp while the battery is being charged, and automatic apparatus for opening and closing the circuit between the generator and battery. The voltmeter is connected to a three-position switch, which provides for determining the voltage of the generator, the battery or the lighting circuit independently. An ammeter switch is provided which is so arranged that the total generator current or the total battery current may be read independently. The knife switch shown in

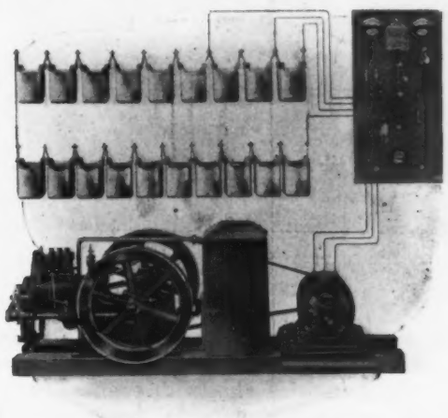


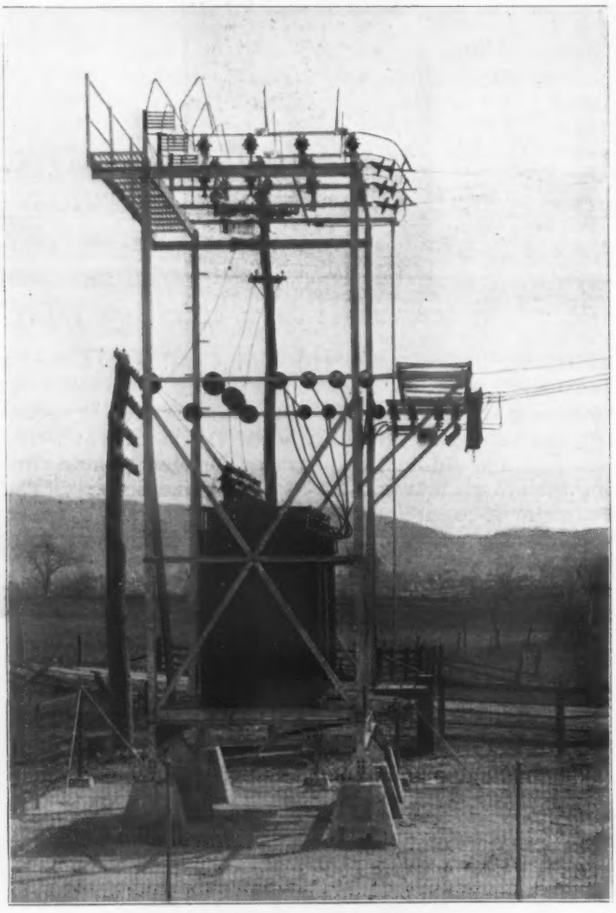
FIG. 2—COMPLETE GASOLINE-ENGINE-DRIVEN GENERATING PLANT

the center of the board is the counter-cell switch and is provided with three contacts. The contacts are spaced so that there is a slight gap when passing from contact

to contact, thus preventing a short-circuit between the counter-cells. The up position gives maximum voltage and places the lighting circuit directly on sixteen cells. The center position cuts in two counter-cells, while the down position cuts in three or as many counter-cells as may be desired. A contactor which is designed to close and open automatically the circuit between the battery and the generator or either the generator or the battery and the line is shown on the lower left-hand side of the board. It is provided with a series shunt winding which closes the circuit between battery and generator when the voltage of the generator reaches a value of about 3 volts above that of the battery. The contactor is provided with a composition carbon and metal contact. The switchboard is of Maine slate and measures 16 in. by 30 in.

Large-Rating Outdoor Substations

The trend toward high-tension outdoor substations of large ratings is evidenced by the form shown in the accompanying illustration. The high-tension lines are



900-KW, 22,000-VOLT, THREE-PHASE STEEL-TOWER OUTDOOR SUBSTATION

connected to the top, and the dead-end insulators are bolted to the station frame. The outgoing low-tension lines are equipped with simple disconnecting switches, choke coils, carbon-tetrachloride fuses and lightning arresters.

The control equipment, consisting of a double-break rotating three-phase switch, is mounted on steel-channel bases, which are bolted to the steel-tower frame. The switch-operating handle is conveniently situated near the ground level and can be locked in either the open or closed position. By means of steps on one corner post of the tower an operator can easily reach the platform, from which point inspections or adjustments can be safely made.

The installation was made by the Delta-Star Electric Company, Chicago, Ill.

Handguard Cut-Outs

The General Electric Company, Ltd., of Great Britain, 67 Queen Victoria Street, London, Eng., has recently

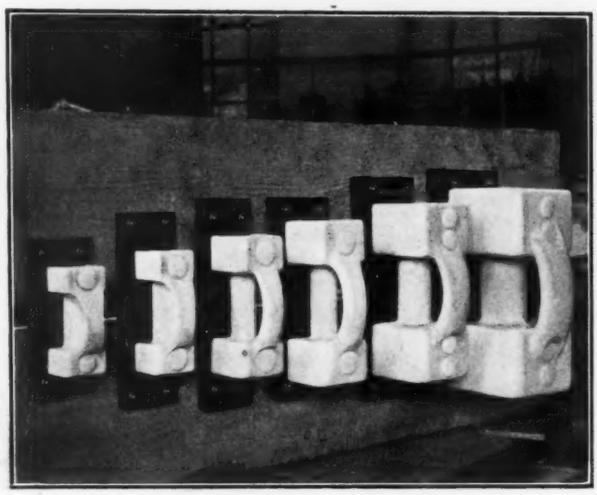


FIG. 1—CUT-OUTS WITH PORCELAIN HANDLES

improved its shielded cut-outs, the latest developments being shown in Fig. 1. The handle and fuse carrier consist of a one-piece porcelain block which completely incloses the fuse-carrier contacts and the clips in the base. The operator is therefore able to get a firm grip on the handle without the liability of touching live parts. The fuse-carrier contact is fastened to the porcelain block by a stud projecting horizontally into the porcelain and is held by a nut, the recess for which is closed by a porcelain cap cemented in. The contact is not held tightly against the porcelain, but is sepa-

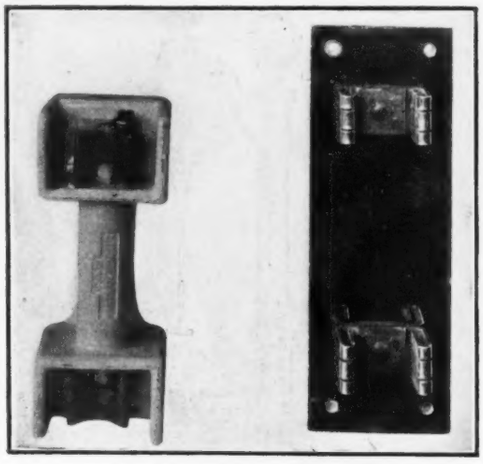


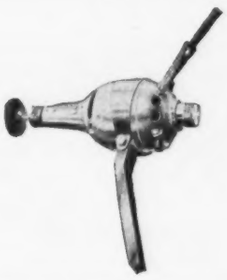
FIG. 2—CUT-OUTS WITH PARTS UNASSEMBLED

rated from it by a spring washer which gives the contact a small amount of freedom in every direction without interfering with its general rigidity. This freedom is sufficient, it is asserted, to enable the contacts to adjust themselves to meet any lack of align-

ment in the clips. As shown in Fig. 2, each contact is cut away at the base so that ample facilities are provided for the access of air to the fuse wire, which is carried in an asbestos tube passing through the tubular carrier. The cut-out is made in a number of ratings ranging from 15 amp to 600 amp.

Portable Electric Grinder

A motor-driven grinder weighing 5.5 lb. which is operated at 10,000 r.p.m. is shown in the accompanying illustration. It can be employed for both internal and



MOTOR-DRIVEN GRINDER

external work and is designed to grind in holes up to 4 in. deep. An arm is provided for supporting it from the slide rest of a lathe. According to the manufacturer, the Sun Electrical Company, Ltd., 118 Charing Cross Road, London, W. C., England, the tool is well adapted for grinding centers, reamers, cutters, dies, etc. The tool is driven by a 1/12-hp motor which operates on either alternating current or direct current.

Oil Circuit-Breakers

Hand-operated single-throw circuit-breakers for pressures up to 2500 volts, with ratings up to 100 amp on alternating current and on direct-current pressures up to 250 volts when the maximum short-circuit current does not exceed 500 amp, have recently been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The type H oil circuit-breakers, as they are called, are being made for both outdoor and indoor use. For the latter purpose a dust-proof wall mounting is employed, and for the former a

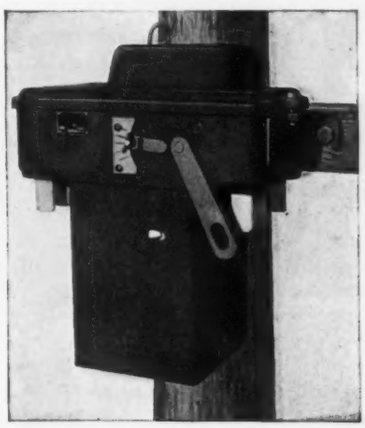


FIG. 1—WEATHER-PROOF OIL CIRCUIT-BREAKER FOR PRESSURES UP TO 750 VOLTS

weather-proof wall or pole mounting. The circuit-breakers are particularly well adapted for use in controlling motor circuits and other circuits of low power-factor. The outdoor type is also useful for mine service.

Butt-type contacts are employed, and use is made of an inverse time element which is operated by dash-pots immersed in oil in the circuit-breaker tank. The dash-pots can be easily adjusted by needle valves. The circuit-breakers are entirely self-contained, the tripping coil, operating mechanism and contacts being inclosed

FIG. 2—OIL CIRCUIT-BREAKER, WITH AMMETER

in a case and immersed in oil. The handle or lever used to close the breaker is attached to a toggle mechanism in such a manner as to produce a heavy pressure between the contact surfaces with only a slight effort on the part of the operator. The oil tank is of heavy iron with all seams welded.

The line leads of the circuit-breakers designed for pressures up to 750 volts are fastened to the terminals by two set screws. With the devices designed for pressures up to 2500 volts "bolted-on" copper-tube terminals are employed. The line leads for the circuit-breakers with dust-proof cases are brought out through porcelain bushings in the top of the case. The line leads for the weather-proof circuit-breakers are brought out through porcelain bushings underneath the case.

The manufacturer claims the following advantages for the circuit-breakers: Compactness in design, ample

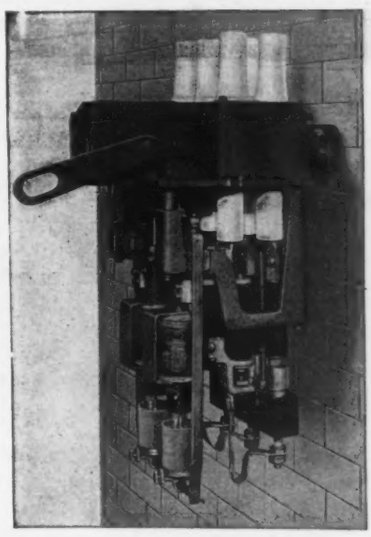


FIG. 3—OIL CIRCUIT-BREAKER FOR PRESSURES UP TO 2500 VOLTS WITH CASE REMOVED

contacts of the butt type, submersion of all contacts in oil, quick opening of contacts, open position maintained by gravity, tanks removable without disturbing the operating mechanism or contacts, self-contained multi-pole operating mechanism.

CURRENT NEWS SECTION

Baltimore Company Offers Stock to Customers

A plan for selling stock to consumers of the Consolidated Gas, Electric Light & Power Company of Baltimore has been made public. It is a policy of Mr. J. E. Aldred, chairman of the board, and he has been working on the project for some time. It is designed to induce customers to become stockholders on easy-payment terms and so effect a closer relationship. According to Mr. Aldred, "the consumers will be enabled to acquire a proprietary interest in the company through the application of their savings month by month to the purchase of shares."

None but customers are included in the offer. No subscriber can anticipate monthly instalments, and it will take slightly more than two years to pay for the stock in full. Subscribers will receive interest on money paid in at the rate of 6 per cent per annum until the stock is fully paid, when the certificates will be delivered.

Announcement of the plan was made in the daily newspapers of Baltimore for several days. Beginning with June 10, notices to customers were delivered with gas and electric bills. Before the customers received the company's statement some applications were received at the offices as a result of the newspaper articles.

Under the plan customers may buy from one share to twenty shares of the common stock and pay for it in monthly instalments of $4 a share, the amount to be placed on the bills submitted each month if patrons so desire. The price at the beginning is $106.50, which is about the prevailing quotation on the stock exchange. The offer will hold good at this price from June 10, when the plan went into effect, until July 10. As the plan is intended to be permanent between the company and its patrons, the price at which the stock may be bought on partial payments will be subject to change every thirty days. This is designed to keep it on an equality with the open market quotations.

Federal Trade Commission Matters

Since their return to Washington members of the Federal Trade Commission have been occupied with the final draft of the rules and regulations, which will be made public next week. A number of other administrative matters have occupied their attention, among them the co-ordination of the economic work of the commission with the legal work. It is understood that the commission intends to hold a number of additional hearings on the subject of foreign trade. These are to be in various cities.

The commission has been clearing its docket of complaints in preparation for these hearings, and has been organizing various boards of investigation, which will serve the same purpose as the board of review of the Interstate Commerce Commission.

Chairman Davies will deliver an address, outlining some of the policies to be pursued by the commission, before the Associated Advertising Clubs of the World in Chicago on June 20.

The commission is to issue shortly, as the result of the work of Mr. Davies while he was Commissioner of Corporations, what is to be called the trust laws report. The trust laws and judicial decisions of the United States, as well as of all of the different states and of all the foreign countries which have laws on the subject of trusts, have been collated. It is understood that the report will contain data which are believed to be especially valuable in connection with the widespread discussion of foreign trade possibilities, relating particularly to the laws that prevail and judicial decisions concerning trusts that have been rendered in Germany and in South and Central American countries.

Thirty-seven retail dealers in New Jersey, Delaware, Maryland and Virginia have filed charges with the Federal Trade Commission against a department store in Philadelphia, alleging unfair trade practices. The department store, it is charged, is endeavoring to induce customers of the complaining stores to open charge accounts with it by offering to sell them underwear at cut-rate prices. The American Fair Trade League collected the evidence, it is understood, on which the charges are based. The league represents several hundred national, state and local organizations of retail dealers throughout the country.

Dr. Steinmetz Discusses Industrial Education

Dr. C. P. Steinmetz, president of the National Association of Corporation Schools, addressed that organization upon industrial education at its fourth annual convention last week in Worcester, Mass. He pointed out that the defects of the modern corporation are few in proportion to its benefits, and traced the rise of organized industrialism from the individualistic production period ending about fifty years ago. Increased activities in the line of welfare work, safety, hygiene, profit-sharing and education indicate the response of the corporation to the demand for organized relations with its employees in place of the old individualistic intercourse.

The speaker sketched the rise of training courses in electrical manufacturing companies and emphasized their influence in increasing the efficiency of the college graduate. "The superiority of America in the electrical industry over all other countries," said Dr. Steinmetz, "is due largely to this educational development and to co-operation between the manufacturing companies and educational institutions."

Vocational training, in the opinion of Dr. Steinmetz, is the most important industrial problem in this country. The supply of artisans with broad training from Europe is now cut off, and the training of workmen in this country is of paramount interest. Between the public and the corporation schools no real conflict exists, each supplementing the other. The former gives a necessary general training and the latter a practical training greatly needed at present. It is the duty of the corporation to see that every community supplies educational facilities for employees even beyond the recognized school age. The public should learn that educational activities of corporations recognize the human side of their problems. The support of the employee is quite as important in the success of an educational program by a corporation as the work of the latter itself. Often the employee resents welfare work as charity, educational attempts are met with

suspicion, and safety campaigns are objected to as an evasion of responsibility on the part of the corporation.

The organization of employees followed the development of industry as a matter of course. It is of doubtful wisdom to attempt to replace a labor organization by one formed by the employer for employees. Human beings are collective and naturally susceptible to leadership. "No constructive ability exists in disorganized masses," said Dr. Steinmetz. "Under a hostile public opinion every political party professes opposition to industrial corporations, but in reality the principle of centralization has always dominated the Republican party, and the concrete achievements of the Democratic administration have been based upon constructive cooperation. Industrial laws are much more powerful than political platforms." In closing, Dr. Steinmetz said that 90 per cent of the work of invention and development is now done under corporation auspices, which share with the universities in the furtherance of research.

During the convention a daily paper was published by the Norton Company and the American Steel & Wire Company of Worcester. These papers contained many articles, including those by Mr. Arthur Williams of the New York Edison Company, on "Foundation Building"; by Mr. H. E. Failes of the National Lamp Works, on "Incentive"; by Mr. F. C. Henderschott of the New York Edison Company, executive secretary of the association, on "Foreign Interest in Corporation Schools"; by Mr. J. W. Dietz, Western Electric Company, on "Practical Co-operation Lacking"; by Mr. R. F. Carey, Westinghouse Machine Company, on "The Backward Boy"; by Mr. Sidney W. Ashe, General Electric Company, on "How Special Apprenticeship Schools Should Be Organized and Developed"; by Mr. W. M. Skiff, National Lamp Works, on "Analysis of Report of the Committee on Employment Plans," and by Mr. Charles R. Sturdevant, American Steel & Wire Company, on "A Training Course for Salesmen."

Among the members of the association are the General Electric Company, Westinghouse Electric & Manufacturing Company, Western Electric Company, American Telephone & Telegraph Company, Public Service Corporation of New Jersey, New York Edison Company and Commonwealth Edison Company of Chicago.

New Department of Justice Policy

It is understood in Washington that a new policy may be adopted by the Department of Justice toward large industrial organizations. Stringent prosecutions under the old Sherman law are to give way, it is said, to a policy of explanation, accommodation and conformation to administrative requirements.

Several severe setbacks sustained by the government in the courts recently will, it is believed, be responsible for this change of policy, if it is undertaken. The government lost in the lower courts in its fight against the United Shoe Machinery Company, the United States Steel Corporation and the National Cash Register Company. It is expected that the decision in the International Harvester Company suit may be handed down in the Supreme Court of the United States next Monday, and it is now believed in Washington that if that decision falls short of a complete victory for the government a radical change in procedure against the trusts will be the result.

While Attorney-General Gregory has announced that he intends to appeal the Steel suit, it is now believed that his course will really depend upon the result of the decision in the Harvester case.

A broad hint has been given from a high official source in Washington to the above effect. Intimations, however, which have been published in the newspapers to the effect that large business concerns in future are to depend in great measure upon the new Federal Trade Commission for information as to what they may do are accepted with reserve. It is not believed that all of the more important work of the Department of Justice is to be given over to the Trade commission or that the department is to be a less important branch of the government in future.

Cleveland Municipal Plant Developments

The report of the public policy committee of the National Electric Light Association presented at the convention in San Francisco on June 7 to 11 contains one section which refers to recent developments regarding the Cleveland municipal electric plant. The information was reported, the committee says, by the Cleveland member of the committee, who is Mr. Samuel Scovil, president of the Cleveland Electric Illuminating Company. The report says in part:

"Cleveland has been operating one or more municipal electric-light plants since 1906. These operations have been at all times a burden to taxpayers, although the rates charged prior to May 1, 1914, were practically the same as those maintained by the private company. No reliable data are available upon which any conclusions can be drawn properly to sustain the claims made by the municipal authorities that it is possible to operate a central station and give satisfactory service at the low maximum rate of 3 cents per kw-hr. adopted, other than by compelling the taxpayers to bear the deficit thus occasioned.

"However, in April, 1914, the city, through its Commissioner of Light and Heat, Mr. Ballard, issued its first so-called 'progress report' of the operations of the plant. It is admitted by Mr. Ballard that the fixed charges—depreciation and interest—have been arrived at on the assumption that they should be apportioned in the relation that the maximum operating load on the station bears to the total overload capacity. Mr. Ballard makes the fixed charges for 1914 against the municipal plant $55,724. Interest and sinking-fund charges on bonds issued for the plant for the years 1913 and 1914 will amount to approximately $124,000. The latter amount was the burden to the taxpayers, though Mr. Ballard says it was not a burden to the taxpayers because he made entries on the plant books apportioning a part of such fixed charges to 'capital' and 'deferred expense' accounts.

"The people of Cleveland in 1911 authorized a two-million-dollar bond issue to provide for an extension of its municipal lighting plant operations. Already this sum has been found insufficient. An additional $700,000 of electric-light bonds, secured by the faith and credit of the city, have been issued by authority of the City Council, without first submitting the question of issuing such bonds to the people. The total amount of bonds outstanding in April, 1915, for account of the old and new municipal plants of Cleveland, aggregates $2,770,000.

"The sinking-fund and interest charges upon this amount of bonds will aggregate approximately $186,000 for 1915, assuming that $22,000 of electric-light bonds issued for account of one of the old plants, due next year, are re-funded on a ten-year basis. The old South Brooklyn plant, which was built in 1906 from funds derived from taxes without the consent of the taxpayers, is now boarded up and abandoned, though still a debt to those who furnished the means to establish it. A small station was installed in the water-works

plant to take care of a certain large consumer which the city had secured, the equipment for this plant being provided by money taken from the water-works department in the amount of some $35,000, which, so far as known, has never been repaid to that department. This plant has likewise been abandoned and the equipment scrapped."

Taxation of Cleveland Plant

Deputy Tax Commissioners Charles P. Salen and James B. Ruhl of Cleveland held a conference with the Ohio Tax Commission on June 7, when the authority of the commissioners to tax the new boat landings and buildings of two lake navigation companies, built on land leased from the city of Cleveland, was discussed. They declared that when city land is diverted from public use to private profit it is subject to taxation. The navigation companies will oppose the movement on the ground that city property cannot be taxed. If the commissioners are sustained by the commission, it is stated that they will raise a question as to whether city property diverted from use for public purposes to use from which a profit is expected is subject to taxation. Should the courts sustain them in this contention, they believe that they would have legal authority to list the new municipal light plant for taxation.

The cable between the new municipal plant and the Collinwood plant has been completed, and the smaller plant ceased generating energy on June 11. In the future it will be used as a substation. Mr. F. W. Ballard, commissioner of light and heat, estimates that the closing of the small plant will mean a saving of about $2,000 a month. He declares that the net yearly receipts from the plant now will be about $300,000.

The Ohio Public Utilities Commission has directed the Cleveland Electric Illuminating Company to increase its bond filed in connection with the rate ordinance passed by the City Council of Cleveland, which is now before the commission, from $1,000,000 to $2,000,000. The new bond has been filed and approved by the commission.

Publicity for Regulation Problems

At a recent meeting of the Boston (Mass.) Society of Civil Engineers Chairman Alonzo R. Weed of the Massachusetts Gas and Electric Light Commission and Chairman Frederick J. McLeod of the Massachusetts Public Service Commission delivered informal addresses upon some of the problems of commission regulation.

Speaking of publicity, Mr. Weed said, in part: "I am confident, personally, that if we had a publicity which was not only complete in itself but which commanded confidence so that people thought that they were getting the truth many of our troubles would solve themselves. I think that we oftentimes get a great deal more truth, that the facts are fully revealed far more than the public gives credit for their being revealed. But there has been a sufficient amount of reticence, there has been a sufficient amount of evasion, of covering up, of trickery at times, to have excited very great distrust in anything like a claim of frankness on the part of the public service corporations. And it works extremely unfavorably, and to the very great disadvantage of those among the men in charge of those corporations who are entirely willing to have the truth known, men of high character who may differ with the public with respect to certain policies but have no disposition at all to have any question raised about facts. A fact is a fact; it is changeless. If we can only know about facts, there is no longer any chance for dispute about them. The only question that remains is as to what theory we shall have with respect to a known thing. We need a publicity in which people have confidence. When we have that I am confident that very many disputes which become exceedingly acute at times will never occur at all."

Mr. Weed also touched upon the desirability of better representation on behalf of the public at commission hearings and deprecated the diversion of engineering ability to work along the lines of determining the reproductive value of property. "We have in this country, for a variety of reasons, come to have a large literature and a wide discussion through technical journals and engineers upon the reproductive value of property," said the speaker. "But it is a speculation, as we all must come to realize, and relates to something which never will happen, and which is never expected to happen; and after you have speculated and reached such agreement as wide differences of opinion, due to varying unit costs and to the elements of value to be considered, make possible, the conclusion really settles nothing permanently. . . . I hope that the tremendous service which engineers do perform and can perform may not be diverted from their real work to what seems to me to be rather a side issue."

Mr. McLeod emphasized the increased burden thrown upon commissions by feeble or inadequate presentation of the public side of questions. He pointed out that the courts are obliged in the main to try cases on the record of the evidence presented by both parties, and that lack of evidence often results in loss to the responsible party. The speaker felt that the commissions may be relied upon to look after the public interest in this respect, but emphasized the disadvantages encountered by municipalities in local hearings before boards of aldermen or selectmen on complex matters beyond the superficial knowledge of their membership. He favored municipal regulation for essentially local matters.

Making Company Section Work More Attractive

Several suggestions for stimulating interest in and securing greater benefit from company-section meetings were brought out during the discussion on company-section topics at the National Electric Light Association convention held June 7 to 11 at San Francisco. Mr. J. M. Strasser of the Public Service Company of Northern Illinois said that that company last year set aside $1,500 to create more interest in company-section meetings. A contest was conducted in which the members presenting the three best papers were offered trips to the San Francisco convention. Sub-sections were organized in each district so that employees desiring to attend meetings would not have to travel to the company headquarters at Chicago, as was formerly necessary. This change almost doubled the membership.

Mr. William H. Atkins of the Edison Electric Illuminating Company of Boston pointed out that the efficiency of central-station employees can be considerably increased if company-section meetings are properly conducted. He then read a written discussion by Mr. F. J. Arnold, chairman of the committee on company sections. The chairman explained that the report of his committee, which was abstracted in the June 12 issue of the ELECTRICAL WORLD, was intended to call the attention of central-station companies to the practical value of local sections and the necessity for showing members thereof the benefits which may be derived from active participation in the meetings.

Continuing, Mr. Arnold pointed out that, although many valuable reports are presented at the annual meetings of the N. E. L. A., they are so voluminous that members seldom have time to digest them carefully. In order that the information contained in these reports

may be utilized, it was suggested that the committee on company sections outline a plan whereby central-station employees performing related duties may meet in groups. At these assemblies abstracts of convention reports and other literature on subjects pertaining to the particular work of each group can be discussed. Some original work should also be done. Dividing company sections into small groups has the advantage of encouraging informal discussions which are difficult to draw out in large meetings. General meetings could be conducted in conjunction with the group discussions, and on such occasions inspirational talks by eminent men and high-grade entertainment could constitute the program.

"Electrical Prosperity Week" Districts

The accompanying map, issued by the Society for Electrical Development, Inc., shows the districts of field committees arranged for the celebration of "Electrical Prosperity Week," Nov. 29 to Dec. 4. The names

FIELD COMMITTEE DISTRICTS FOR "ELECTRICAL PROSPERITY WEEK"

of the members of the various sectional committees, as announced by the society, were published in the ELECTRICAL WORLD of June 12, 1915. Other names are to be added to the committees as the plans for the celebration progress.

Electric Companies Entertain Motor-Service Customers

One hundred of the largest electric motor-service users in the vicinity of Bloomsburg, Pa., met recently at a local park as the guests of the Columbia & Montour Electric Company and the Northumberland County Gas & Electric Company. The session was held in the large dance hall and was followed by a banquet and entertainment in the evening.

Mr. Stephen C. Pohe, general manager, presided, and in his introductory remarks explained that the gathering was for the purpose of getting together to form a closer relationship between the consumer and the companies. Mr. Fred T. Ikeler spoke briefly on "Co-operation," pointing out the unity of interests between the companies and their customers. He traced the growth of the co-operative idea in the industrial and commercial world, especially with respect to public service corporations, and emphasized the benefits to be derived by both producer and consumer from a mutual and intelligent understanding. In conclusion, he expressed his belief that great good would result from a gathering of this character. Mr. C. B. Cushing, of the Pennsylvania Electrical Engineering Company of Scranton, spoke on "Motors, Type and Application." He pointed out the necessity of analyzing the conditions of the work to be done before choosing the type of motors to be used and also summed up the advantages of motor drive over mechanical drive. In speaking on "Electric Power Versus Steam, Gas or Oil-Engine Drive," Mr. Louis T. Peck, of the Westinghouse Electric & Manufacturing Company, covered fully the many advantages gained from the use of electric power over the use of steam, gas or oil-engine drive. Mr. S. G. Reeque, electrical engineer, presented a map showing the lines of the companies and spoke of their facilities for growth.

Mr. Charles Hodge, of the Harwood Electric Company, spoke of developments in the Harwood system. Mr. George Phillips, superintendent of the meter department of the Columbia & Montour company, explained in detail the principles of various types of meters. He was followed by Mr. Henry M. Diehl, superintendent of the meter department of the Northumberland company. Mr. J. F. Richards, commercial engineer of the Columbia & Montour Company, read a paper on "Central Station Versus Isolated Plants," emphasizing the benefits to the consumer who uses central-station energy.

Electric-Vehicle Topics Discussed at San Francisco Convention

An outline of the electric-vehicle situation on the Pacific Coast, the difference between selling motor-driven vehicles and central-station energy, the inconsistency of electric-service companies employing gasoline-engine-driven automobiles when advocating the use of electric vehicles, and the reasons for the high cost of electric cars, constituted the principal topics in connection with electric vehicles which were discussed at the National Electric Light Association convention in San Francisco.

Mr. George R. Murphy, representing the Electric Storage Battery Company, in speaking of the use of electric vehicles on the Pacific Coast, pointed out that the electric-service companies, with few exceptions, are supplied with energy over long transmission lines, therefore the operation and maintenance departments must employ vehicles which will travel a long distance without being compelled to stop frequently for supplies of energy. Nevertheless, the central-station companies in large communities are using and encouraging the use of electric vehicles where possible. Conditions are specially favorable to the use of electric vehicles in Los Angeles, San Diego, Sacramento, Stockton, Fresno and Oakland, but there are numerous hills in San Francisco, Portland, Tacoma and Seattle. In San Francisco the grades reach a maximum of approximately 30 per cent, and it is inadvisable to run loaded commercial vehicles on such streets because of the limited braking facilities. Electric vehicles are being used, however, on streets having a grade of from 16 to 20 per cent. Where the hills are as steep as those in San Francisco larger batteries must be employed than are required in more level places. Where this fact is overlooked by enthusiastic vehicle salesmen there is likely to be complaint regarding the inability of electric vehicles to climb hills or to run long periods between charges. Wherever electric vehicles have been selected with characteristics suited to the service they are required to perform complete satisfaction has been reported. There are at present in the three Pacific Coast States approximately 265 commercial electric vehicles, ranging in carrying capacity from 750 lb. to 5 tons. In no city is there any very large fleet of trucks. Instead, they are distributed among a large number of owners.

A close co-operation between vehicle manufacturers

and central stations is absolutely necessary, pointed out Mr. Murphy, if the use of electric vehicles is to be increased. This is evident in Spokane and San Francisco, where the central-station companies have established a battery-service system. With this system owners of trucks are guaranteed expert attention to batteries at a lower annual expense than could be obtained otherwise. Furthermore, the radius of action of vehicles is increased. For example, one baggage-transfer company operates between four or five railroad terminals and is able to cover 75 miles a day with a 1-ton vehicle. Without the battery-service system this mileage could not be attained unless extra batteries or another truck were purchased.

If electric-vehicle manufacturers expect to develop their industry they must maintain service stations within convenient reach of every community in which it is desirable to sell electric vehicles. Mr. Murphy declared that he knew of electric trucks being inoperative for three weeks, waiting for special parts to be ordered and received from the manufacturer, 3000 miles away.

Mr. R. L. Lloyd of the Philadelphia Electric Company said that the process of selling electric vehicles is entirely different from the sale of electrical energy, as the salesman cannot complete the deal unless his company has taken an agency. The speaker expressed the belief that electric-vehicle salesmen should not lay too much emphasis on the low rate which prospective vehicle users may obtain in purchasing energy for charging batteries. Other advantages should be pointed out to interest prospective users. When the company is required to sell energy at too low a rate, there will be no inducement for central stations to encourage the use of electric vehicles unless it is to fill the valleys in the load curve.

There is still a great deal of educating to be done as too many persons consider that electric vehicles are luxuries and chiefly for the use of women. The speaker expressed the belief that a battery-service system similar to that maintained by the electric-service company of Hartford, Conn., would encourage the use of electric vehicles in many other cities, as electric-vehicle users would then have to purchase only the vehicle and not the battery.

Mr. Arthur Williams of the New York Edison Company expressed the belief that the performance of electric vehicles on steep hills cannot be equaled by other types of vehicles. He also said that it is a reflection on the industry for so many central-station companies to employ gasoline-engine-driven and horse-drawn vehicles while advocating the use of electric vehicles. To give some idea of the prospective field for business lying at the door of every central station, the speaker said that the cost of feeding horses in this country is at least three times the total central-station income, which is assumed to be $350,000,000. As the difficulty of substituting electric vehicles for horse-drawn vehicles lies in the expense of the change, it might be possible for central stations to replace horses with electric vehicles by issuing equipment-trust certificates similar to those employed by railroads.

Mr. John F. Gilchrist said that there is altogether too much tendency among central-station companies to argue that before anything worth while can be done in developing the electric-vehicle industry the price of vehicles must be reduced. On the other hand, vehicle manufacturers are arguing that rates for electric service are too high and that central-station companies have not given sufficient consideration to their own interests. The speaker agreed with the latter opinion, and stated that the Commonwealth Edison Company has only recently begun to give attention to the exploitation of electric vehicles. In many ways the support of important persons in the electrical industry has been lacking, at least so far as using electric automobiles personally is concerned. It was suggested that if men who are influential in electric-service organizations would prevail upon their superiors to use electric vehicles and furnish them to the heads of different departments the interests of the company would be extended and a wide field provided for the electric-vehicle industry.

Mr. Herbert A. Wagner pointed out that the cost of electric vehicles, particularly in small sizes, is high compared with the cost of gasoline-engine-driven vehicles because the former are produced on a much smaller scale. The production will be increased, and consequently the cost will be reduced, if every central station will purchase at least one electric vehicle and encourage persons in the territory it serves to use similar vehicles.

In closing the discussion, Mr. A. J. Marshall, secretary of the Electric Vehicle Association of America, declared that there are about 2700 commercial electric cars in New York City, or about 45 per cent of the total number—gas and electric—used there. He also referred to an organization in New York City which is preparing to operate electric taxicabs in all of the principal cities in this country. In closing, he said that if a gasoline car and an electric vehicle were started together at Forty-second Street, New York City, in the direction of the lower end of the city, the electric car would arrive at the Battery first.

Electric-Railway Strike in Chicago

Fourteen thousand employees of the Chicago surface lines and elevated railroads struck for increased wages at 5 a.m. on June 14, seriously affecting all business. No facilities on either surface lines or elevated roads were available. Steam railroads, vehicles and boats were taxed to the limit of their capacities to handle the crowds for two days. On June 16, largely through the efforts of Mayor Thompson, the trainmen, who had refused previously to submit their demands to arbitration, decided to arbitrate. Service was therefore resumed on all lines. Agreement was come to that the difficulties should be submitted to a committee of three for arbitration, the committee to consist of Mayor Thompson, representing the city, and one representative each from the companies and the union. Should the decision be in favor of the men the increase in wages will date from June 1.

Both the surface lines and the elevated railways purchase energy from the Commonwealth Edison Company. It is estimated that at this season of the year the surface lines create an electrical demand of 100,000 kw and use about 1,080,000 kw-hr. in a twenty-four-hour day. The demand of the elevated roads is approximately 28,000 kw, and their daily consumption is about 140,000 kw-hr.

In order to insure continuity of service the Chicago Telephone Company housed about 1000 of its switchboard operators temporarily in downtown hotels. One of the large retail dry-goods stores advertised an increase in its telephone switchboard facilities and promised prompt electric motor-truck deliveries of all telephone orders.

Judge Kohlsaat of the United States District Court at Chicago issued an order on June 15 directing Mr. Samuel Insull, as receiver of the Chicago & Oak Park Elevated Railroad Company, to resume operation of the line at once, to employ such men as might be available for the purpose, and to report to the court any interference with the operation of the trains so that the court might take suitable measures. The order held that the striking trainmen were really court employees.

Miscellaneous News Notes

Vote on Franchise Provision at Los Angeles.—At the election on June 1 voters of Los Angeles, Cal., recommended by a vote of four to one that the City Council refuse to grant a renewal of franchise to any company which refuses to interchange service with another company. The franchise of the Sunset Telephone & Telegraph Company will expire in November, 1916, and the present vote will be used to urge it to install arrangements for interchanging service with the Home company.

Rate Negotiations in Cincinnati.—The Federated Improvement Association discussed at the Gibson House, Cincinnati, Ohio, on June 10, a proposal to eliminate a minimum rate for service by the Union Gas & Electric Company in any new franchise that may be formulated. The report of the municipal lighting committee of the organization estimated that the rate could be based on the King report and still return 8 per cent on the investment as found by the Public Utilities Commission. The association is advocating a maximum rate of 6 cents per kw-hr.

"Shaders" to Screen Porches from Chicago Street Lamps.—Young people in Chicago who spend their evenings on verandas near street lamps are jubilant, for under an ordinance just passed by the City Council porch cozy corners need no longer be subjected to the baleful glare of too much illumination. Upon application "shaders" will now be fitted on the offending lamps by the Department of Gas and Electricity, upon the payment of $3 initial charge and a maintenance charge of $1 a year. Already, it is stated, more than 1000 applications have been received for such shading of lamps.

Legislation in Pennsylvania.—Governor Brumbaugh of Pennsylvania has vetoed Bill No. 783, authorizing municipalities which own water-works or electric-light plants to lease them with the consent of the Public Service Commission. "Such unlimited and absolute power in a matter so vital to the welfare of the people of a municipality ought not to be given to any commission," the Governor said. The Governor approved an act which permits all cities outside of Philadelphia to acquire self-sustaining public utilities without having the cost charged against them in calculating the bonded debt so as to keep within the limit authorized by law.

Old Rose Polytechnic Institute Property Sold.—The Terre Haute (Ind.) board of school trustees has purchased the entire present plant of the Rose Polytechnic Institute for $100,000. The property includes ten acres of ground. The purchase includes also machines, equipment and other property, amounting to about $30,000. The institute is to retain possession of the buildings until August, 1917, and has the option of remaining for one year longer. It will pay $4,000 a year rental. Some time ago the institute bought a large tract of land near Terre Haute on which to erect new buildings. The buildings at the new location are being constructed as rapidly as possible.

Arbitration for Commercial Disputes.—Arbitration for commercial disputes occurring in trade between Latin-American countries and the United States, which was discussed at the Pan-American Financial Conference in Washington in May, is the subject of action by a committee appointed at that time. Among the members of this committee are Messrs. James G. White and Mr. Frank A. Vanderlip of New York and also two of the delegates from Argentina. The committee members agreed unanimously upon a plan to be operated under the supervision of the Buenos Aires Chamber of Commerce and the Chamber of Commerce of the United States.

Course in Electricity for Business Men.—The State University of Kentucky at Lexington has announced a business men's summer course in electricity, beginning June 14 and ending Aug. 7, to be held daily from 11 a. m. to 12 m. The tuition for the eight weeks is $15. Prof. W. E. Freeman, professor of electrical engineering, will direct the course. The curriculum, which is especially arranged for the benefit of business men, is intended to teach the many elementary things about electricity that the average person does not know. The meaning of the simple terms of the science, reading of meters, cost of operating devices now in common use in the household, the important part played by electricity in every-day life—these and many other similar phases of the art will be presented.

Commercial Education for Foreign Trade.—The National Foreign Trade Council of New York has sent letters to the heads of 1000 corporations and firms engaged in foreign trade asking responses to five questions bearing on the adaptability of the American system of commercial education to the needs of foreign trade and what changes should be made to render the system more helpful. The inquiry is made through the committee on commercial education for foreign trade, which is composed of business men and educators. The data obtained will be communicated to a large number of educators and made the basis for a consultation of educational opinion, with the idea that this will lead to changes in curricula.

Electrical Trade Opportunities in South America.—At a luncheon of the New England Section of the National Electric Light Association held June 10 at the American House, Boston, Mass., Mr. T. F. Anderson, secretary of the New England Shoe and Leather Association, told of the trade opportunities for American manufacturers in South America. "No part of the world presents greater opportunities for the introduction of electric power and apparatus than does South America. There the development of mines, agriculture and transportation, in which electric power and lighting must play an important part, is already under way. Chile, Peru and Bolivia are now brought so near to us by means of the Panama Canal that exceptional opportunities have resulted for American electrical engineers and manufacturers."

Regulatory Bills in Illinois.—Three bills passed by the Senate of the Illinois Legislature on June 10 give authority to a city commission to be appointed by the Mayor of Chicago to authorize the merger of elevated railways and surface lines, by lease, purchase, operating agreement or otherwise, and to fix the terms and conditions of merger. Complete and exclusive control of all public utilities within Chicago is also vested in the city commission without Council interference or consultation. The bills in substance deprive the City Council of the powers over utilities which it still possesses and practically confer upon the proposed commission all powers of regulation and control formerly exercised by the Council and the State Public Utilities Commission. Another bill providing for the regulation of utilities companies in Illinois by local city councils, which was pending in the Legislature for several weeks, was defeated in the House on June 9. Reports from Springfield indicate that politics played an important part in the final vote.

Associations and Societies

Outing in Detroit.—Members of various Detroit engineering societies planned to participate in an outing at Bois Blanc on June 19, under the auspices of the Detroit Engineering Society.

Outing at Louisville, Ky.—More than 300 Jovians and their friends went on the recent river excursion on the steamer *Corona*. A surplus was left for the reserve fund of the organization. Numerous prizes won in various contests were electrical appliances.

Electroplaters' Society of America.—The Electroplaters' Society of America held a three-day convention at the Algonquin Hotel, Dayton, Ohio, June 3 to 5. Among the features of the program was an address by Dr. William Blum of the Bureau of Standards, Washington, D. C.

Officers of Cleveland Electrical League.—On June 7 the directors of the Cleveland Electrical League at a meeting at the Hollenden Hotel elected the following officers for the ensuing year: President, Mr. M. H. Moffett; vice-president, Mr. N. H. Boynton; treasurer, Mr. J. S. Hurd; executive secretary, Mr. R. S. Dunning, re-elected.

Lehigh Valley Section Meeting.—Mr. A. H. Swanbeld, of the National X-Ray Reflector Company, was the guest of honor at the regular June meeting of the Lehigh Valley Light & Power Company Section of the National Electric Light Association, held on June 8, at Allentown, Pa. Mr. Swanbeld's address on "Indirect Lighting" was the principal feature of the evening.

Council Meeting, Electric Vehicle Association.—Matters of importance to the Electric Vehicle Association of America will come before the meeting of the association council called for next Friday, June 25, at E. V. A. headquarters, New York City. Mr. A. Jackson Marshall, secretary, will be present, having returned from an extended trip through the West in the interests of the association.

Northern White Cedar Association.—A special private sleeping car will leave Minneapolis, Minn., at 2 p. m. Friday, June 25, with the members of the Northern White Cedar Association, who will hold their annual summer meeting, fishing and outing from June 26 to June 29 in the Lake-of-the Woods country near the northern border of Minnesota. Mr. T. M. Partridge, Lumber Exchange, Minneapolis, is chairman of the outing committee.

Brooklyn Section, N. E. L. A.—The seventh annual convention of the Brooklyn Edison Company Section of the National Electric Light Association will be held at the Oriental Hotel, Manhattan Beach, Coney Island, New York, June 23. The business session will begin at 2 p. m., and the meeting will close with a banquet tendered the members of the section by the Edison Electric Illuminating Company of Brooklyn. Mr. C. H. Stevens is chairman of the Brooklyn section.

Pittsburgh Section of Illuminating Engineering Society.—One hundred members of the Pittsburgh Section of the Illuminating Engineering Society and their friends made an inspection trip to the United States Glass Company plant, Southside, Pittsburgh, on the evening of June 11 and inspected methods of manufacture of cut glass, table glassware and illuminating fixtures. Afterward the party returned to the Fort Pitt Hotel, where an informal luncheon was served.

Jovian Rejuvenation at Saginaw, Mich.—About forty members of the local Jovian League attended the rejuvenation at the Elks' Temple, Saginaw, Mich, when a banquet was held at which Mr. F. B. Drees, of the Standard Electric Stove Company of Toledo, Ohio, acted as toastmaster. Among those who spoke during the evening were Messrs. A. D. Furlong, general manager of the Saginaw (Mich.) Power Company; Norman Brush of the Capitol Supply Company of Lansing, Mich.; Edward Meyers of the National Carbon Company; William Trott of the Fostoria Incandescent Lamp Company, Grand Rapids, and P. F. Shagane, Flint, president of the Michigan division of the National Electrical contractors.

Dinner of Cleveland Engineering Society.—The annual dinner of the Cleveland Engineering Society was held at the Hotel Statler on the evening of June 8, with 350 members and guests present. Mr. Elliott H. Whitlock presided as toastmaster. Mayor Newton D. Baker, Dr. Leonard P. Ayers, director of the Russell Sage foundation; Mr. David Bell, Buffalo, and President Arnold Stucki of the Engineering Society of Western Pennsylvania made addresses. The organization decided to provide a scholarship fund to enable Cleveland young men to secure a technical education. A delegation of about 100 members will attend the meeting of the American Society of Mechanical Engineers to be held at Buffalo during the week of June 22.

Convention Cruise, Michigan Section, N. E. L. A.—No formal papers will be presented at the annual convention of the Michigan Section of the National Electric Light Association, which is to be held aboard the steamship *Rochester* on Lakes Huron, Superior and Michigan, from June 26 to 30. Mr. D. R. Kennedy of Youngstown, Ohio, will, however, speak on "Safety"; Mr. J. B. Oxtoby of Detroit will present an address on some legal topic, and Mr. F. A. Hewton of Jackson will speak on rates. In round-table meetings which have been planned to occupy the time of most of the sessions discussions on the following topics will be held: Comparative operating costs of gas-filled tungsten lamps and magnetite-are lamps, concentric wiring, oil engines, rural electric-service lines, uniform accounting, and the requirements of the central-station salesman. At one session of the convention the association's associate members, who are manufacturers and jobbers, will be invited to take part in a discussion on the ideal buyer and the relations that should prevail between the central-station buyer and the seller of electrical merchandise.

Public Service Commission News

Missouri Commission

An order has been issued by the commission requiring the Union Electric Light & Power Company of St. Louis to file a complete inventory and statement of its finances on or before Oct. 1, 1915. Among the data requested are: Analysis of the investment in plant and equipment in service; analysis of other investments, showing land, buildings and equipment not devoted to operation; analysis of capital-stock accounts, showing for what consideration capital stock was issued; analysis of surplus account, showing profits or losses for each year and their disposition; analysis of funded debt, showing for what consideration funded debt was issued and how invested. Consumers are to be distinguished as resident, commercial, municipal, power and flat-rate. The connected load and monthly consumption in kilowatt-hours of each consumer and the revenue received therefrom are to be shown, and all consumers of like connected loads and equal consumption in each month are to be indicated. Commercial and flat-rate consumers are to be grouped as three classes of business. A list of all consumers having special rates is to be given. The engineers of the commission are directed to make a physical valuation and the accountants to examine the accounts.

The order that has been issued by the commission follows a complaint by the Engineers' Incitation Club of St. Louis alleging that rates are too high and are discriminatory and that contracts between the company and the Keokuk Power Company are collusive. The company filed an answer denying that its rates were either too high or discriminatory or that its contracts with the Keokuk company are collusive. Mr. W. F. Woerner, formerly a member of the commission, is attorney for the Engineers' Incitation Club.

Ohio Commission

A decision has been rendered by the commission on the appeal from the ordinance passed by the Council of the village of Marysville, Ohio, to regulate electrical rates of the Marysville Light & Water Company. A complaint, signed by thirty-eight electors of the village, was filed with the commission, alleging that the rate ordinance passed by the Council on Aug. 18, 1914, was unjust and unreasonable and would allow the company to receive an excessive and unreasonable rate upon its property actually used and useful for the convenience of the public in furnishing the service. To this complaint a demurrer was interposed by the company, on the grounds that the commission has no jurisdiction of the subject, and that the statute under which the proceeding is sought to be prosecuted is in contravention of the constitution of Ohio.

While it is well settled, the decision says, that nothing in the United States Constitution or laws serves to prevent a state from creating a commission of this character, or from an express delegation of power granted to the General Assembly by the State Constitution to classify corporations and confer upon proper commissions or officers supervisory and regulatory powers over the organization, business and issue and sale of stock and securities thereof, to assume to determine the issue raised by the demurrer would lead the commission into the domain occupied exclusively by the judicial branch of the government, and it would be exercising a power that is not and cannot be confided to it. The commission must administer the law as it finds it and cannot assume to question or determine the constitutionality or validity of the statutes under which it operates and from which its jurisdiction is exclusively derived. The commission therefore overruled the demurrer that had been interposed by the company.

The commission has ordered an appraisal of the properties of the Columbus Railway, Power & Light Company used and useful in furnishing energy for the public. The valuation will be made as of July 1, and the company has been requested to file an inventory as soon as possible. The city requested a valuation a year ago when the franchise, under which the company had been furnishing service at a maximum rate of 7 cents per kw-hr., expired. An arrangement was effected by which the old rate is to be continued until such time as the appraisal that has been ordered by the commission shall have been completed.

Maine Commission

The commission has issued a general classification of service for each public utility. The classification of service for electrical companies follows: Lighting; lighting of buildings other than residences; electrical energy used in lighting places or things other than buildings; electrical energy used for power; electrical energy used for heat; all service where a minimum or meter charge, or both, is made; all service where the customer's use of energy is not continuous, or where the company's installation is for a short period of time, including summer (or seasonal) service.

The commission has refused permission to the Black Stream Electric Company to issue capital stock at less than par. The company proposes to operate in the towns of Carmel, Hermon and Levant in Penobscot County. It convinced the board that it has a fair field for service and reasonable prospects of success. The company did not propose to offer bonds for sale until its capital stock was subscribed and paid in. The Maine law does not prohibit the sale of stock at less than par. The commission stated in its decision that it makes no ruling at this time relative to the issue of additional stock by corporations already doing business, but said that in the financing of a new utility the stock should be issued at par. The board holds that in this way the public will be better able to judge the value of the securities, that assets will thus better keep pace with book values, and that subsequent purchasers of securities are less likely to be losers in case of readjustments of rates and charges, based as these should be on the actual value of the property.

Indiana Commission

The commission has received an opinion from Attorney-General Richard M. Milburn that interprets the utility law in its application to the regulation of service powers in a manner that is much less broad than the view entertained by some authorities. The Attorney-General holds that "service" cannot be applied to new construction; in other words, that the commission has no authority to order a traction company to construct an entirely new line of tracks in a city simply because it has authority to regulate "service" to an adequate point. The case arose when 400 citizens of Fort Wayne, Ind., petitioned the commission to order the Fort Wayne & Northern Indiana Traction Company to construct some new lines of track.

The commission has approved a new rate schedule for the Avilla Light & Power Company of Avilla.

It is understood that an expert on rate-making, probably from the Wisconsin Railroad Commission, is to go to Indianapolis to verify the figures of the Indiana commission in the light and heat rate-making decisions that are about to be rendered affecting the Indianapolis Light & Heat Company and the Merchants' Heat & Light Company.

Idaho Commission

An initial "get acquainted" trip of the commission to northern Idaho to meet the people and bring the commission closer to them has just been completed. Stops were made in all of the more important cities and towns, hearings were held in regard to charges made for electric energy, and other public utility questions were considered. The commission finished its trip by making an inspection of the route of what is known as the "missing link" in the north and south Idaho railroad. If feasible, Governor Alexander has announced that he will call a special session of the Legislature to take action to lend financial assistance if necessary for construction of the road.

Pennsylvania Commission

A complaint has been filed by residents of Hamburg, Pa., with the commission, protesting against the rates charged for street lighting by the Hamburg Gas & Electric Company, and demanding reparation for alleged over-charges.

Washington Commission

At the request of the Newport Council, the commission has dismissed the complaint of the town that the rates of the Northern Idaho & Montana Power Company were excessive. The valuation of the company's property by the commission engineer made it plain that the company was not earning more than a fair return on its investment.

Personal

Mr. A. R. Taylor has been appointed superintendent of the Prescott (Ark.) municipal water and lighting plant.

Mr. Elmer W. Smith has succeeded Mr. S. P. Curtis as manager of the Consolidated Light & Power Company, Kewanee, Ill.

Mr. C. H. Blossom has been elected president and manager of the Burt (Ia.) Light & Power Company, succeeding Mr. L. M. Owen.

Mr. A. I. Early is the new local manager at Hillsboro of the Southern Illinois Light & Power Company, succeeding Mr. C. L. Clary.

Mr. L. G. Stockwell has resigned from the Union Electric Light & Power Company, St. Louis, Mo., to engage in private engineering work.

Mr. S. W. Dietrich has resigned from his position as electrical superintendent of the Fresno (Cal.) district of the San Joaquin Light & Power Corporation.

Mr. W. K. Stacy, formerly assistant electrical engineer of the Washington Water Power Company, has entered the electric-vehicle business at Spokane, Wash.

Mr. E. F. Putnam has been appointed assistant superintendent of the Naugatuck and Seymour (Conn.) divisions of the United Electric Light & Water Company.

Mr. Huntington B. Crouse, president of the Crouse-Hinds Company, Syracuse, N. Y., has been elected a director of the Trust & Deposit Company of Onondaga, N. Y.

Mr. James M. Howe has been appointed manager of the Ordway Electric Light & Power Company of Ordway, Col., succeeding Mr. M. S. Slaughter, who resigned June 1.

Mr. L. G. Ireland has been appointed manager of the Brantford (Ont.) street railway in addition to his position as manager for the Hydro-Electric System at Brantford.

Mr. C. E. Fahrney, manager of the Ottumwa (Ia.) Railway & Light Company, has been appointed a member of the executive board of the Iowa Street Railway Association.

Mr. George Harding, manager of the Kootenai Power Company, Ltd., of Cœur d'Alene, Idaho, has been elected vice-president of the company, succeeding Mr. S. A. Easton.

Mr. William Y. Cartwright, vice-president of the Union Gas & Electric Company of Cincinnati, Ohio, is the new president-elect of the Natural Gas Association of America.

Mr. E. M. Collis, a survivor of the *Lusitania* disaster, who is in the employ of the Commonwealth Edison Company of Chicago, has returned to his home at Riverside, Ill.

Mr. Frederick J. Rankin, who was until recently an instructor in the Central Station Institute, Chicago, has been appointed electrical engineer for the Colorado Utility Commission.

Mr. W. F. Wells, second vice-president and general manager of the Edison Electric Illuminating Company of Brooklyn, was given the degree of Master of Arts by Rutgers College on June 15.

Mr. L. N. Jenkins, formerly with the Omaha (Neb.) Electric Light & Power Company, has succeeded Mr. L. D. Wright as water and light commissioner in charge of the municipal electric light and water works at Fremont, Neb.

Mr. Arthur J. McCarron has been appointed by the International Brotherhood of Electrical Workers to represent it on the general committee which will work with the Bureau of Standards in formulating safety rules for electrical construction. Mr. McCarron is by trade a cable splicer.

Mr. R. W. Berliner, who for the last two years has been general manager of the Colonial Power & Light Company, the Claremont Railway & Lighting Company and the Claremont Power Company, all of Claremont, N. H., has been appointed engineer in charge of general construction work in the South and East for the Eastern Power & Light Corporation, which controls the Claremont companies. Mr. Berliner's headquarters after July 1 will be in New York City.

Mr. George H. Caffrey, manager of the Abilene (Tex.) Gas & Electric Company, has been elected president of the company to succeed Mr. E. W. Powell. Mr. Caffrey will

continue in the capacity of manager of the company. Prior to going to Texas he was associated with the United Electric Light & Water Company as superintendent of the Norwalk (Conn.) division and later became engineer for the Havana (Cuba) Railways & Light Company. Mr. Caffrey is a graduate of the Stevens Institute of Technology.

Mr. J. E. Davidson, vice-president and general manager of the Pacific Power & Light Company, Portland, Ore., who was appointed a member of the executive committee of the National Electric Light Association at the San Francisco convention last week, has just been elected chairman of the Portland Section of the N. E. L. A. Mr. Davidson, who is well known in central-station circles as one of the most progressive utility managers in the country, became associated with the Pacific Power & Light Company five years ago in the capacity of commercial manager. Following his later appointments as manager and as vice-president, Mr. Davidson was placed in charge of matters of engineering, new business, purchasing, taxes and stores, in addition to his duties in connection with the maintenance and operating departments, of which he had previously had supervision. Mr. Davidson was formerly with the public utility companies at Port Huron, Mich., and was later president and manager of the Consolidated Lighting Company of Montpelier, Vt. He was president of the Vermont Electrical Association in 1909, president of the New England Section of the N. E. L. A. in 1910-1911, and president of the Northwest Electric Association in 1911-1912.

J. E. DAVIDSON

Mr. Alten S. Miller, the secretary-elect of the Illuminating Engineering Society, has been prominently identified with the electrical and gas-lighting industries of this country in many executive and engineering capacities. He was born at Richmond, Va., in 1868 and was graduated from the Stevens Institute of Technology in 1888 with the degree of mechanical engineer. In 1894 Mr. Miller went to New York as engineer of the East River Gas Company of Long Island City. This company was later consolidated with one of the New York companies, forming the New Amsterdam Gas Company, of which Mr. Miller became engineer. While holding that position he was in 1900 made constructing engineer of the Consolidated Gas Company of New York. In 1902 he became manager of the Consolidated Gas Company of Baltimore, Md., and in 1905 was made vice-president and general manager of the Consolidated Gas, Electric Light & Power Company of that city. While in Baltimore he built a new electric generating plant to replace former non-condensing plants, and also a new gas plant to replace three other gas works that had become obsolete. In 1909 Mr. Miller went to St. Louis as president of the Union Electric Light & Power Company. There much was accomplished in reducing operating expenses and in gaining for the company the confidence and good will of the public. Much time was also spent in valuing the property and in other details of a rate case before the local public service commission. In 1911 he returned to New York and joined Dr. Alexander C. Humphreys in the firm of Humphreys & Miller, Inc. Since then he has confined his work to consulting engineering and has made a special study of valuations and rate cases in connection with public service properties.

A. S. MILLER

Obituary

G. B. Shuck, superintendent of the Palmyra (Mo.) electric-lighting plant, died at Hannibal, Mo., June 5. Mr. Shuck was a graduate of the University of Missouri.

Jesse F. Church, for a number of years manager of the Willimantic (Conn.) Gas & Electric Light Company, died at Schenectady, N. Y., June 8, following an operation for appendicitis. Mr. Church was fifty-eight years of age.

J. Washburn Melendy, president of the Melendy Telephone Company of South Londonderry, Vt., died at his home on June 13 at the age of sixty-nine. He had served as State Senator and was known throughout the Green Mountain State as one of its most public-spirited citizens.

Joshua Hale, for some years a partner in the consulting electrical engineering firm of Blood & Hale, Boston, Mass., and more recently in private practice in close association with banking houses, was killed by an automobile at Newburyport, Mass., on June 15, as he was about to take a train for Boston. Mr. Hale was born in Boston in 1869 and was educated at Harvard College and at the Massachusetts Institute of Technology. He was a man of broad sympathies, prominent in public affairs in Newburyport, where he resided, and was active in church matters and club work.

Charles Edward Chinnock, one of the pioneers of the electrical industry and for many years closely associated with Mr. Thomas A. Edison, died June 11 at the age of seventy years. Mr. Chinnock entered the electrical field in 1872 as electrician for the Bell Telephone Company, New York City, under Mr. Theodore Vail, and remained in that capacity until 1882, when he joined the staff of Mr. Edison and was appointed vice-president and general manager of the Edison Electric Illuminating Company of New York City, remaining on the board of directors and the executive board until early in the spring of 1888, when he resigned to accept the position of vice-president and general manager of the Edison United Company of New York and was succeeded by Mr. John I. Beggs. In 1890 Mr. Chinnock organized the Edison Electric Illuminating Company of Brooklyn and was elected its vice-president. After placing the company in good condition, he resigned and accepted the position of district manager for all the southern district of the General Electric Company. He resigned in 1894 and entered the field as an organizer He made many valuable inventions, among them an electric time lock, which is used extensively in this country by banks; "anti-induction" cables, which were first used over the Brooklyn Bridge for telephone purposes, and the jenny used for cable hanging by telephone companies. His last invention was the "omnigraph" for teaching the Morse code for wireless telegraphy. He was president of the company that is engaged in promoting this invention at the time of his death.

CHARLES E. CHINNOCK

Harry Byng, third son of the late Gustav Byng, founder and chairman of the General Electric Company, Ltd., of Great Britain, was killed in action May 16 while leading a platoon of the regiment in which he was serving as second lieutenant. Mr. Byng was twenty-six years of age. After preliminary schooling at Harrow and Faraday House in England he came to the United States and entered Harvard University, and while there was captain of the Harvard association-football eleven. Leaving Cambridge, he joined an exploring expedition into Canada, and after a trip to England entered the apprenticeship course of the General Electric Company at Schenectady, N. Y. Later he returned to the General Electric Company, Ltd., of London, and at the outbreak of the war had settled in Warwickshire in order to be near the works at Wickham.

Corporate and Financial

American Gas & Electric Company, New York, N. Y.—For the third time in the last eighteen months the company has declared in addition to its regular quarterly dividends an extra stock dividend of 2 per cent on the common stock. The dividends are payable on July 1.

Camaguey (Cuba) Company, Ltd.—A meeting has been called for June 22 to consider an offer from the Electric Bond and Share Company to purchase the properties for $500,000, subject to the outstanding bonds. The capital stock of the company is $1,000,000 and outstanding bonds amount to over $500,000. For the last two years the company has passed its common-stock dividends.

Duquesne Light Company, Pittsburgh, Pa.—Owing to the depression due to the European war and other causes, conditions in the Pittsburgh district have been affected severely, according to the company's annual report. Notwithstanding this, the company has 48,486 contracts in force, an increase during the year of 5389, representing an increased motor-service load of 12,759 hp and an increased lighting load of 4667 kw, while municipal lighting shows an increase of 1254 lamps. The new equipment at Brunot Island and improvements and betterments at other generating stations have effected a saving in operation of $236,646, while the plants are in better condition for efficient operation than ever before. During the present year the company expects to install rotary converters at the Manchester and Glenwood power plants to furnish direct current to the Pittsburgh Railways, and these plants will not be operated as generating stations. It is estimated that this will effect considerable saving. The summary of income and profit and loss for the year ended March 31, 1915, follows:

Gross earnings		$4,938,862
Operating expenses:		
Production	$1,377,655	
Transmission and distribution	455,473	
Consumers	61,484	
Municipal street lighting	83,357	
Laboratory	24,244	
Commercial	190,293	
General and miscellaneous	371,688	
Steam heating	6,023	
Total operating expenses	$2,570,217	
Taxes	167,363	
Total operating expenses and taxes		2,737,580
Net earnings		$2,201,282
Other income:		
Dividends on stock owned	$103,167	
Interest and discount	155,489	
Miscellaneous	2	
Total other income		258,658
Total income		$2,459,940
Deductions from income:		
Rent of leased properties	$196,889	
Rent of power stations	291,236	
Interest and discount	158,069	
Miscellaneous	23,842	
Total deductions from income		670,036
Net income before deducting fixed charge		$1,789,904
Fixed charge—Interest on funded debt		20,800
Net income after deducting fixed charge		$1,769,104
Other deductions:		
Discount, taxes and expenses in connection with the sale of securities	$57,800	
Deferred improvements and betterments written off	7,947	
Provision for depreciation	139,207	
Total other deductions		204,954
Net income for the year		$1,564,150
Surplus, April 1, 1914		243,743
Gross surplus		$1,807,893
Deductions from surplus:		
Dividend on preferred stock	$46	
Dividend on common stock	1,236,730	
Total deductions from surplus		1,236,776
Surplus March 31, 1915—per balance sheet		$571,117

Frederica (Del.) Water, Light & Power Company.—The property, which was ordered sold at public sale, was bid in by Dr. F. W. Frankhauser, of Reading, Pa., one of the largest bondholders.

Greenfield (Mass.) Electric Light & Power Company.—At a meeting of stockholders it was voted to increase the stock from $750,000 to $1,000,000. Application will be filed with the Board of Gas and Electric Light Commissioners for permission to issue the stock. The proceeds are to pay for recent extensions and for work to be done at the plant, where nearly all of the boilers are to be replaced by larger units.

Hanford Irrigation & Power Company, Portland, Ore.—The assets, which were purchased at the recent receiver's sale by Mr. Henry K. T. Lyons of Denver for $285,000, have been transferred to three corporations. The power plant at Priest Rapids, the pumping station at Coyote and the transmission lands are taken over by the Black Rock Power & Irrigation Company, which will manufacture and distribute electrical energy. The Agathon Land Company takes the unsold lands and the bills receivable, and the Consumers' Ditch Company the irrigation system which supplies farmers in the White Bluffs and Hanford district with energy.

Hortonia Power Company, Hortonville, Vt.—Application has been made to the Vermont Public Service Commission for permission to increase the capital stock to $250,000 and to issue thirty-year 5 per cent bonds up to $600,000.

Indiana Utilities Company, Angola, Ind.—The Indiana Public Service Commission has confirmed the sale of the Ashley municipal electric-light plant, damaged by fire recently, to the Indiana Utilities Company, and also the franchise to furnish energy for lighting and motor service and a ten-year contract for lighting the streets.

Louisville (Ky.) Gas & Electric Company.—The New York Stock Exchange has listed $8,500,000 first and refunding mortgage five-year 6 per cent bonds, dated July 1, 1913.

Manchester (N. H.) Traction, Light & Power Company.—The New Hampshire Public Service Commission has authorized the company to issue $1,000,000 of 5 per cent notes at not less than 95. The proceeds will be used to retire floating debt and to provide for new construction.

Marianna (Ark.) Electric Company.—The Arkansas Light & Water Company, an Arkansas corporation, has purchased the holdings of the Marianna Electric Company, owned by the Light & Development Company of St. Louis, Mo., and the municipal water-works plant of the city of Marianna. The sale of the two plants ends the litigation between the electric company and the city of Marianna, and it is understood that a fifty-year franchise will be granted to the new company.

Northwestern Electric Company, Portland, Ore.—An issue of $3,000,000 first mortgage 6 per cent twenty-year sinking-fund gold bonds, due on May 1, 1935, is offered at par and interest.

Northwestern Ohio Light Company, Urbana, Ohio.—Application has been filed with the Ohio Public Utilities Commission for permission to issue $481,000 common stock and $318,000 bonds to be exchanged for the securities of the smaller companies now operating in Van Wert, Delphos, Deshler, Leipsic and Urbana, which will be consolidated if the authority is granted.

Public Light & Power Company, Winchester, Tenn.—An initial issue of $850,000 of first mortgage 5 per cent sinking-fund gold bonds due Feb. 1, 1945, is offered at 90 and interest, with 40 per cent bonus in common stock.

Sandusky River Power Company, Fremont, Ohio.—Notice has been filed with the State that the corporate name of the company will be changed to the Ohio State Power Company. Application has also been made for an increase of capital stock from $900,000 to $1,000,000. The company has requested permission from the Public Utilities Commission to issue $700,000 bonds and $100,000 preferred stock. The application for the securities was made in an emergency, and it is said that the new steam plant which has been planned and already started will cost $200,000 less in construction than usual if the work can be pushed through at once. The property is now in the hands of a receiver and the plan for reorganization is progressing. The old company operated a hydroelectric station, but because of very low water during certain parts of the year it will be abandoned and the new steam generating station, on which construction has been started, will provide the energy. The new station will have a rating of 15,000 kw, and the generating equipment will be of the Allis-Chalmers type and the boilers of Babcock & Wilcox make. The energy generated by the company is now sold to the Lake Shore Elec-

tric Railway Company, which will take practically its entire demand from the new company on completion of the project.

Santa Barbara (Cal.) Gas & Electric Company.—The California Railroad Commission has issued a supplemental order authorizing the issue of $11,000 first mortgage 6 per cent thirty-year gold bonds.

Scranton (Pa.) Electric Company.—A block of $231,000 of first and refunding (now first) mortgage 5 per cent gold bonds due on July 1, 1937, was sold recently at par and interest.

Southern Power Company, Charlotte, N. C.—First mortgage 5 per cent gold bonds, due on March 1, 1930, are offered at 99 and interest. Earnings for the year ended April 30, 1915, follow:

Gross earnings	$2,485,790
Operating expenses, taxes and rentals	1,039,017
Net earnings	$1,446,773
Annual bond interest	350,000
Balance	$1,096,773

Texas Power & Light Company, Dallas, Tex.—It is reported that the company has acquired additional franchises and will build transmission lines from its plant at Waco south to Temple, Taylor and Thrall, and will erect a large generating plant on the Red River near Denison. Other additions and maintenance of a twenty-four-hour service in city and country are planned.

United Light & Railways Company, Grand Rapids, Mich.—Notices have been sent to holders of second preferred stock advising them that they are entitled to exchange their present holdings of second preferred 3 per cent cumulative stock for either first preferred 6 per cent cumulative stock or common stock, par for par. This privilege takes effect June 15, and under the terms of the charter exchanges may be made for sixty days thereafter.

Utica (N. Y.) Gas & Electric Company.—An issue of $350,000 refunding and extension mortgage 5 per cent gold bonds, due on July 1, 1957, is offered at 99 and interest. Earnings for the year ended April 30, 1915 follow:

Gross earnings	$1,284,984
Operating expenses and taxes	675,815
Net earnings	$609,169
Annual bond interest charges	287,000
Balance	$322,169

Washington Water Power Company, Spokane, Wash.—The property of the corporation is to be offered at public sale, according to an agreement reached in the federal court before Judge Cushman. Attorneys report that opposition has been removed, and a decree was presented for foreclosure of a $1,569,000 mortgage under which the Fidelity Trust Company of Philadelphia is trustee.

Waynesboro (Pa.) Electric Company.—It has been announced that New York engineers representing a syndicate have secured options on all of the privately owned gas, railway and electric-light utilities in Chambersburg, Waynesboro, Shippensburg and Green Castle. It will require, it is said, $2,000,000 to acquire the properties and another $2,000,000 to provide for certain necessary extensions. Options were obtained on control of the following companies: Shippensburg Gas & Electric Company, Chambersburg Gas Company, Chambersburg & Shippensburg Railway Company, Chambersburg & Gettysburg Electric Railway Company, Chambersburg, Green Castle & Waynesboro Street Railway Company, Green Castle Electric Company, Waynesboro Electric Light & Power Company, Waynesboro Gas Company and Mercersburg Turnpike Company.

Western Canada Power Company, Ltd., Vancouver, B. C.—The annual report for the year ended Dec. 31, 1914, states that during the first six months of 1914 there was every indication of a steady recovery from the industrial depression of the previous year on the Pacific Coast. The company had prepared to complete the installation of the third and fourth generating units at the power house at Stave Falls during the year 1914-15, and was looking forward to an early realization of its expectations. The outbreak of the European war at once affected the business of the company's customers very seriously, and the directors decided to postpone indefinitely the work of construction, discharged the engineering staff, and reduced operating expenses wherever possible. This depression resulted in a considerable temporary loss of business, as even the best customers of the company have restricted their supply to the minimum under their contracts. It was proposed during 1914 to install the third generating unit complete with penstock and switches. The turbine for this unit was received in Vancouver early in September. The fourth turbine is now completed, but cannot be shipped until after the war is over. The two additional generators and the eight large transformers are completed and are held in storage. The switchboards were also completed, but were only partly erected when construction work was stopped. An additional expenditure of about $90,000 is required to complete the installation of the third generating unit and the installation of the fourth generating unit, which is partly paid for, will require an additional expenditure of about $165,000. Eventually the completion of the dams necessary to operate these four units to their full capacity will cost $400,000, and the completed installation will then produce 52,000 hp. In December last the company authorized an increase of its issue of first mortgage bonds from $5,000,000 to $6,000,000, and a portion of this new issue of $1,000,000 has been pledged to secure existing indebtedness. Any considerable revival on the Pacific Coast will insure corresponding increases in the revenues. The profit and loss account for the year follows:

Earnings:	
Sale of energy, rentals of machinery, etc.	$315,801
Balance	23,848
Total	$339,649
Operating expenses, including production and distribution, general expense, rentals, taxes, etc.	$87,149
Additional reserve for doubtful accounts	2,500
Interest on first mortgage bonds	250,000
Total	$339,649

Western Power Company, San Francisco, Cal.—Articles of incorporation have been filed in Albany, N. Y., for the Western Power Company of New York, with 146,700 shares of common stock without par value and 70,800 shares of 6 per cent preferred stock of $100 par value. This is in accordance with the plan of the Western Power Company of New Jersey, announced last summer, to reincorporate under New York laws in order to provide for the dividends on the preferred stock, which accumulated to the amount of 18 per cent from Jan. 1, 1912, to Jan. 1, 1915. The accumulated dividends will be paid in preferred stock, holders of preferred stock in the New Jersey company to receive for each 100 shares deposited 118 shares of preferred stock of the New York company. For the old common stock, with a par value of $100, an equal number of shares of the New York company without par value will be distributed. The following acted as a committee in carrying out the plans: Messrs. Irving W. Bonbright, A. W. Burchard, F. Lothrop, A. C. Bedford, M. Fleishhacker and H. P. Wilson.

J. G. White Companies, New York, N. Y.—In the annual report to stockholders Mr. J. G. White, the president, states that general financial and business conditions during the early part of last year, which were intensified by the hostilities in Europe, made it impossible to secure large engineering or construction work, and even more impossible to arrange any large flotations or promotions of either new projects or consolidations of existing businesses. Owing partly to the writing down of security values to correspond to current quotations at the date of the balance sheet, or their values as determined by special committees of directors, and partly to dividends paid during last year, the combined surplus shows a decrease of more than $200,000 as compared with the year before. A revaluation as of April 24, 1915, of securities owned would show an increase in the surplus over that shown for 1914 of more than $250,000. This would bring the actual surplus as of to-day up to more than $800,000, which would be slightly larger than the surplus shown in the consolidated balance sheet of Dec. 31, 1913. During the last few months new business in encouraging, though not large, volume has been arranged, and in the opinion of the officers the prospects to-day seem better than they have been at any time since before the outbreak of European hostilities. The amalgamated balance sheet shows, as of Dec. 31, 1914, current assets of $1,025,969, made up of $509,669 in cash in banks, branch offices and on hand and $516,300 for accounts receivable after making deductions for doubtful accounts.

Manufacturing and Industrial

K. McLennan & Company, manufacturers of commutator compound, have moved from 308 Times Building, New York, to 102 North Fifth Avenue, Chicago, Ill.

The Hoyt Electrical Instrument Works, Penacook, N. H., have appointed Mr. E. M. Hobbs district sales manager, with headquarters at 967½ Woodward Avenue, Detroit, Mich.

The Wagner Electric Manufacturing Company, St. Louis, Mo., has opened an office in the Walker Bank Building, Salt Lake City, Utah, which will be in charge of Mr. F. C. Morton.

The Corliss Carbon Company, Bradford, Pa., manufacturer of motor and generator brushes, has opened an office at 1052 People's Gas Building, Chicago, Ill. The Western district is in charge of Mr. F. D. Frawley.

The Terry Steam Turbine Company, Hartford, Conn., has appointed Mr. Joseph Battles as district sales manager for territory in New Mexico, Colorado, Wyoming and the western part of Nebraska. Mr. Battles' headquarters will be at 326 First National Bank Building, Denver, Col.

Electric Welding Apparatus for Metropolitan Engineering Company.—The largest electric welding apparatus in Brooklyn, N. Y., is now being installed in the factory of the Metropolitan Engineering Company on Atlantic Avenue. The new installation will require 650 kw for its operation.

George K. Webster, Inc., South Ferry Building, New York, is an importer of electrical chandeliers and various types of lighting fixtures. The firm has recently been organized, and Mr. George K. Webster is president. Mr. Webster was formerly with the East Side Metal Spinning Company and the Art Chandelier & Bronze Company of New York.

Electric Manufacturer on Trade Trip.—The James Clark, Jr., Electric Company, Louisville, Ky., was represented on a recent trade trip through eastern Kentucky, western Virginia and east Tennessee which was conducted by the Louisville Commercial Club to boost trade for Louisville. It was made in a special train and was of four days' duration.

The Pittsburgh Electric Specialties Company of Pittsburgh, Pa., was recently incorporated in the State of Illinois with a capital of $50,000. The company has opened a branch office at 218 South Wabash Avenue, Chicago. The capital of the corporation in the State of Pennsylvania is $250,000. Mr. A. C. Wales is attorney-in-fact in Illinois for the company.

The Hoskins Manufacturing Company, 453 Lawton Avenue, Detroit, Mich., has appointed Mr. W. C. Tharp as district manager in charge of its Pittsburgh office to succeed Mr. I. J. Shults, who has resigned. Mr. Tharp has been associated with the Republic Iron & Steel Company, the Scientific Materials Company and the Metallurgical Testing Laboratory of Pittsburgh.

Thew & Luhr, 110 North Fifteenth Street, Omaha, Neb., electrical contractors, have taken over the business formerly conducted by the West Side Electric Company. Mr. H. H. Thew is president and manager of the concern, Mr. W. E. Luhr is vice-president and secretary, and Mr. M. L. Thew is treasurer. These officers also had charge of the West Side Electric Company.

Order for Small Electric Furnace.—The Snyder Electric Furnace Company, 53 West Jackson Boulevard, Chicago, Ill., has recently received an order from S. Fair & Son, Inc., Saginaw, Mich., for a small electric furnace. The furnace will have a twenty-four hour output of 8 tons of refined steel. It will run on cold melts and will be utilized in the manufacture of vanadium steel castings.

Sprague Electric Club.—A large gathering of the members of the commercial and manufacturing departments of the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York, recently took place at the Hotel Marlborough, New York, for dinner and organized the Sprague Electric Club. It will be the purpose of the club to bring the salesmen, engineers, factory heads and other employees into closer contact and co-operation. The club adopted a constitution and by-laws and elected a board of governors and officers, and plans were formulated for a series of meetings.

Mr. Charles T. Pfaltz, treasurer for Duhrssen & Pfaltz, Inc., 19 East Seventeenth Street, New York, selling agent for the Pope Metal Lamp Company of Venlo, Holland, has just returned from a trip through Holland and Germany. Mr. Pfaltz declares that conditions in Germany are good and everybody seems to be well employed. Mr. Pfaltz made arrangements with the Pope Metal Lamp Company to obtain a full shipment of tungsten, nitrogen and carbon lamps and reflectors.

Electrical Equipment for Colombia.—Consul Ross Hazeltine, Cartagena, Colombia, reports that American manufacturers furnish about 57 per cent of the total imports of electric motors, material and pumps entering Colombia through the port of Cartagena. He also reports that the equipment of the electric-light plant at Cartagena will need replacing in the near future and directs the attention of American manufacturers of generators, boilers for wood fuel, and other equipment to this prospective trade opportunity.

Company Formed to Manufacture Automobile Headlamps.—The Tu-Wa Headlight Company, 703 Paul Jones Building, Louisville, Ky., has acquired the patent rights of the "Zimmerman dirigible headlamp." The apparatus consists of two electric lamps, which are mounted on brackets and connected to the steering gear so that one lamp turns in the direction to which the car is turned, thus providing a light immediately ahead of the automobile. It can be speedily attached to any automobile, it is declared, and a special bracket is provided for Ford cars. The Tu-Wa Company is capitalized at $20,000, and the headlamp is being manufactured for the company by the American Iron Works, 524 East Main Street, Louisville.

Tractor Company Takes Central-Station Service.—The Hart-Parr Tractor Company of Charles City, Ia., which is said to have the largest gasoline-engine tractor plant in the world, has contracted for electric service with the local central-station company. Formerly the electricity used in this factory was generated by the gasoline engines on test, which were connected to 50-kw generators. The great demand for tractors of smaller sizes has, however, caused the firm to curtail the production of the 60-hp units which were used to drive these generators. Since the use of smaller units to produce electricity would be impracticable and uneconomical, the company has decided to install two 200-kw, 2300/220-volt motor-generator sets and to take energy from the Charles City plant of the Cedar Valley Electric Company.

New Glass Plant.—The Holophane Works of the General Electric Company, Cleveland, Ohio, have recently opened a large plant for the manufacture of glass shades and reflectors for electric and gas fixtures. The plant includes ten buildings and covers a space of 12.5 acres. The equipment is said to represent an investment of $1,500,000 and is designed to turn out 10,000 pieces a day. The building of the plant was decided upon before the European war, which has forced the closing of most of the Belgian, French and Bohemian factories. With the new installation the company will be able to compete successfully with foreign concerns, and it is understood that it is pushing its foreign sales aggressively, especially in South America. It is reported that a number of satisfactory orders for foreign shipment have already been received.

Electrical Equipment Approved by Bureau of Mines.—The Bureau of Mines, Department of the Interior, has recently approved a miner's portable electric cap lamp, manufactured by the Edison Storage Battery Company of Orange, N. J. Approval No. 10 has been issued to the company. The only bulbs so far approved for use with the lamps are the "26-V" bulbs manufactured by the Independent Lamp & Wire Company, 1733 Broadway, New York. The bureau has also approved, for use in gaseous mines, an explosion-proof coal-cutting equipment made by the Sullivan Machinery Company, Claremont, N. H. The apparatus consists of an explosion-proof electric motor, an explosion-proof starting rheostat and fuse, and an explosion-proof cable reel. Approvals No. 100 and No. 100-A have been issued to the Sullivan Machinery Company. All approved equipment will be distinguished by a plate bearing the seal of the Bureau of Mines, the approval number and other information relative to the approval.

Storage Batteries for Small Town-Lighting Systems.—The Barber-Dwinnell Electric & Manufacturing Company, Kansas City, Mo., has recently installed one of its improved storage-battery lighting systems at Athol, Kan. The set includes a 35-hp International Harvester Company oil engine and a 20-kw Northwestern generator. The engine is operated each day until 11 p. m., when it is shut down and the battery, which is rated at 250 amp-hr., carries the lighting load for the rest of the night. Mr. O. W. Taylor of Burwell, Neb., a town of 1200 inhabitants, recently ordered an outfit consisting of a 37.5-kva generator, a 50-hp oil engine and battery. The outfit is the second bought by Mr. Taylor within a year, the plant being utilized to provide power for pumping the city water. Another order recently received by the Barber-Dwinnell Company is from the Flour & Grain Company of Springview, Neb. The order included a set of the Barber-Dwinnell company's "Triumph" batteries, which is utilized for supplying energy for the city lighting and motor load. The battery is rated at 350 amp-hr. for eight hours and is employed at night when the generator at the mill is shut down.

NEW YORK METAL MARKET PRICES

	June 8 Selling Prices Bid	Asked	June 15 Selling Prices Bid	Asked
Copper:	£ s d		£ s d	
London, standard spot*	82 10 0		86 5 0	
Prime Lake	19.50 to 19.75		20.37½ to 20.62½	
Electrolytic	19.50 to 19.75		20.25 to 20.50	
Casting	18.50 to 18.75		19.25 to 19.37½	
Copper wire base	20.75 to 21.00†		21.50 to 22.00†	
Lead	5.75		7.00	
Nickel	45.00 to 48.00		45.00 to 48.00	
Sheet zinc, f.o.b. smelter	30.00†		30.00†	
Spelter	26.00 to 27.00†		22.00 to 22.50†	
Straits tin	40.25		42.50†	
Aluminum, 98 to 99 per cent.	28.00 to 29.00		28.00 to 30.00	

*OLD METALS

Heavy copper and wire	17.75	18.75
Brass, heavy	13.00	15.00
Brass, light	11.25	11.50
Lead, heavy	5.25	6.62½
Zinc, scrap	21.00	17.00

*COPPER EXPORTS

Total tons to June 15	9822

*From daily transactions on the New York Metal Exchange.
†Nominal.

New Industrial Companies

The Electro-Wound Clock Company, of New York, N. Y., has been incorporated with a capital stock of $50,000 by J. S. and N. Friedman and C. Ehrlich, 597 Trinity Avenue, New York, N. Y. The company purposes to manufacture watches and clocks.

The Industrial Equipment Company, of New York, N. Y., has been chartered with a capital stock of $10,000 to manufacture electrical and mechanical apparatus, etc. The incorporators are Arthur H. Ferber, Samuel B. Von Der Smith and James J. Donohue.

The Carl H. Page Motors Company, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture motors, engines, machinery, etc. The incorporators are E. K. R. Kruse, H. B. Leary and A. J. Bryant, 55 Broadway, New York, N. Y.

The Kurz Electrical Company, of New York, N. Y., has been incorporated by L. Coleman, 1087 Atlantic Avenue, Brooklyn; W. M. Smythe, 41 Garden Place, Brooklyn, and C. T. Kurz, 485 East 139th Street, the Bronx. The company is capitalized at $25,000 and purposes to manufacture lamps, machinery and appliances for gas and electricity.

The Yale Electric Company, of New Haven, Conn., has been incorporated by George S. Rubin, 51 Orange Street, New Haven, Conn.; Arthur C. Olney, of New York, N. Y., and George O. Brott, of Hartford, Conn. The company is capitalized at $100,000 and purposes to manufacture electrical apparatus for use in surgical and dental work and X-ray machines.

New Incorporations

The Tompkinsville Electric Light & Ice Company, of Tompkinsville, Ky., has been incorporated with a capital stock of $10,000 by E. H. Smith, J. R. White and H. B. Smith.

The Hope Light & Power Company, of Augusta, Maine, has been incorporated with a capital stock of $25,000. The officers are: R. S. Buzzell, president; L. J. Coleman, treasurer, and C. L. Andrews, clerk.

The Northern Utilities Company, of Eveleth, Minn., has been incorporated by F. B. Myers, of Biwabik, Minn.; J. A. Kennedy, of Virginia; T. F. Lynch and J. P. Boyle, of Eveleth, and J. P. Smith, of Duluth, Minn. The company is capitalized at $50,000 and intends to do a general lighting and heating business.

Trade Publications

Fused-Plug Receptacles.—The Detroit (Mich.) Fuse & Manufacturing Company has prepared Bulletin No. 35, on its "Square D" fused-plug receptacles.

Small Motors.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is sending out a folder on its small single-phase motors.

Synchronous Converters.—Bulletin 1092 published by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., describes some of its large-sized synchronous converters.

Motor-Generator Sets.—Bulletin 42,552 issued by the General Electric Company, Schenectady, N. Y., is an illustrated publication of twenty-eight pages and is entitled "Motor-Generator Sets."

Insulating Material.—The Pressed Asbestos Products Company, 451 West Nineteenth Street, New York, has issued a booklet which describes and illustrates its "papco" insulating material.

Lighting Fixture for Shaving.—A. B. Wilson, Leader Building, Cleveland, Ohio, is sending out an illustrated leaflet which contains information on a lighting fixture and mirror for shaving.

Feather Valve for Air Compressor.—The Laidlaw feather valve for air compressors is described in Bulletin L-530 and Bulletin No. 23 published by the International Steam Pump Company, 115 Broadway.

Electric Hammers.—The Electro-Magnetic Tool Company, 2902 Carroll Avenue, Chicago, Ill., is sending out a folder which describes its electric hammer for operation on either alternating current or direct current.

Small Generating Plant.—The Globe Electric Company has published Catalog No. 2, on its small gasoline-engine-driven generating plants, and Bulletin No. 4, on its type A switchboard for generating plants with storage batteries.

Starting Switches for Alternating-Current Motors.—Bulletin B-54 published by the Allen-Bradley Company, 495 Clinton Street, Milwaukee, Wis., describes and illustrates its type H resistance starting switch for alternating-current induction motors.

Electrical Devices.—The Metropolitan Engineering Company, Forty-second Street Building, New York, is sending out a number of loose leaflets on its nitrogen-lamp containers, high-potential cut-outs, subway boxes, copper terminals and contactors. These supersede leaflets already published.

South American Market.—The American Express Company has prepared an illustrated booklet which contains information on a first-hand investigation into the market, trade conditions and financial systems of the South American nations made by representatives from the New York Central lines and the American Express Company.

Electrical Apparatus.—The Western Electric Company, New York, has issued booklets and folders on Sturtevant vacuum cleaners, Benjamin automobile accessories, excess indicators, transformers, "Bluebell" batteries for local and long-distance telephones, telephone switchboards, lamp cords and portable cords, portable telephone booths, small electric-lighting plants, direct-current commutating-pole motors, and dealers' helps for selling its "interphones."

Construction News

New England

MANCHESTER, N. H.—The Public Service Commission has approved of the proposed $1,000,000 loan of the Manchester Trac., Lt. & Pwr. Co. Of the proceeds $450,000 will be used for payment of work already done. The proposed new work includes the North End substation and the steam power plant at Kelley's Falls.

AMESBURY, MASS.—The property of the Hamilton Woolen Co., including lands, buildings, water rights, water-power, water privileges, etc., in Amesbury and Salisbury, has been purchased by the Merrimac Valley Pwr. & Building Co., with principal office in Boston. A deed of trust has been recorded by the Merrimac Valley company to the Beacon Trust Co. to secure an issue of $290,000 in bonds. The Merrimac company is capitalized at $400,000. George A. Clark and John W. Robbins are interested in the company.

GREENFIELD, MASS.—The stockholders of the Greenfield El. Lt. & Pwr. Co. have voted to increase the capital stock of the company from $750,000 to $1,000,000, the proceeds to be used to pay for recent extensions and for the proposed rebuilding of the boiler plant.

LYNN, MASS.—The Lynn Gas & El. Co. is installing a 4000-kw General Electric turbo-generator unit with necessary auxiliaries and switchboard equipment. The company has recently installed a 20-ton electrically operated Niles crane.

TAUNTON, MASS.—Within the next six months the city of Taunton expects to purchase for the municipal electric-light plant from 50 to 100 watt-hour meters, 200 kw in transformers (25 kw and over), 1000 to 1500 insulators, 50 to 75 poles, 10 to 15 miles of wire, usual pole-line hardware, 50 street-lamp brackets for incandescent lamps; also some electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, etc. Leland D. Wood is manager.

TURNERS FALLS, MASS.—The Turners Falls Pwr. & El. Co. has awarded a contract to Fred T. Ley & Co., of Springfield, for the construction of a new dam at Turners Falls, between Great Island and the Gill side of the Connecticut River.

Middle Atlantic

ALBANY, N. Y.—Bids will be received by the Board of Contract and Supply, City Hall, Albany, until June 21 as follows: (1) For furnishing and installing electric time and program clock system, telephone system, lighting fixtures, lamps and vacuum cleaner plant in school No. 14; (2) electric lamp posts for Albany Basin Bridge; (10) electric motors and wiring and electric irons for manual training and domestic science classes for schools Nos. 14, 16 and 18. Forms of proposal and specifications, etc., may be seen at the above office.

BEACON, N. Y.—Preparations are being made by the City Council for the installation of new street lamps on Main Street from Bank Square to Fountain Square, replacing the arc lamps now in use. The cost of the system is estimated at about $6,000.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, until June 28, for additions, alterations and repairs to electric equipment in Public Schools 5, 46, 68, 103, 159 and 186, borough of Manhattan. Blank forms, plans and specifications may be obtained or seen at the above office.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, until June 21 for additions, alterations and repairs to the electric equipment in Public Schools 10, 15, 17, 25, 26, 27, 33 and 43, and Morris High School, borough of the Bronx. Bids will also be received at the same time and place for alterations and additions to the electrical equipment in Curtis High School, borough of Richmond. Blank forms and plans may be seen at the above office and also at branch office, Borough Hall, New Brighton, borough of Richmond.

PULASKI, N. Y.—The Pulaski El. Lt. Co. is planning to extend its transmission lines to furnish electricity in Richland Junction and Sandy Creek, and is also planning to erect a line to Orwell to supply electrical service there. The village of Altmar, 9 miles from Pulaski, is also planning to secure electrical service.

TOMPKINSVILLE, N. Y.—Bids will be received at the office of the lighthouse inspector, Tompkinsville, until June 22 for furnishing one complete electric arc-welding outfit for general lighthouse depot, Tompkinsville. Blank proposals and particulars may be had upon application to the above office. J. T. Yates is inspectior.

WATERTOWN, N. Y.—The Northern New York Utilities Co., Inc., is reported to be contemplating the construction of a power plant at Elmer's Falls on the Beaver River, 1½ miles above the plant at Taylorsville.

WELLSVILLE, N. Y.—The village of Wellsville has applied to the Public Service Commission for approval of the acquisition of an existing electric-lighting system in Wellsville and for operating and maintaining same.

DORRANCETON, PA.—Plans are being prepared by Bellinger & Perrot, architects and engineers, of Philadelphia, it is reported, for a power house for the Duplan Silk Co.

ELLWOOD CITY, PA.—Plans have been completed for the Shelby Tube Co., of Ellwood City, for the erection of several additional mills at its plant. The additions and improvements contemplated will involve an expenditure of about $1,000,000.

MARKES, PA.—The property of the Conococheague Lt., Ht. & Pwr. Co., of Markes, is reported to have been purchased by a syndicate consisting of Edward J. Post, J. Harvey Cooper and Samuel B. Shearer, who, it is said, are interested in the proposed electric railway to be built between McConnellsburg and Fort London.

PITTSTON, PA.—The Pittston School Board has authorized the secretary to advertise for bids for a complete electrical plant for the city schools. The purpose in securing bids is to determine whether a lighting system owned by the district would be cheaper than the rates charged by the Citizens' El. Illg. Co.

RENOVO, PA.—Bids will be received by the board of education of the Renovo School District, Renovo, until July 1, for construction of a High School Building at Renovo. Separate bids will be received for heating and ventilating, plumbing and electrical work. Plans and specifications may be obtained on application to Woodnutt & Schmohl, 150 West Fourth Street, Williamsport.

SHARPSBURG, PA.—A company has been organized by local citizens to construct and operate an electric-light plant. Machinery for the proposed plant, it is understood, has been purchased.

WATERFORD, PA.—Within the next 10 days the Waterford El. Lt. Co. expects to install equipment in new substation (150-kw output). All machinery and material has been purchased. B. E. Waltz is secretary and superintendent.

BAYONNE, N. J.—The City Commissioners are considering the installation of an ornamental street-lighting system on Broadway. Overhead wires may be placed underground.

CAMDEN, N. J.—The Public Ser. El. Co. is planning to install 11,000 ft. of underground conduits on Market Street and Broadway.

JERSEY CITY, N. J.—The City Commissioners are negotiating with the Public Ser. El. Co. for the installation of an ornamental lighting system on Jackson, Ocean, Central and Monticello Avenues and Grove Street.

PATERSON, N. J.—The Board of Education has engaged Lewis E. Eaton, mechanical engineer, to prepare plans and specifications for the proposed light and power plant for the high school, for which $5,000 has been appropriated.

TRENTON, N. J.—J. N. Baggett, illuminating engineer, of Baltimore, Md., engaged by the city of Trenton to investigate the local lighting conditions, has submitted his report to the City Commissioners in which he recommends replacing the present lamps now operated from the underground service with luminous direct-current arc lamps, the substitution of 80-cp nitrogen lamps for arc lamps in the residential sections, and the complete elimination of the gas lamps, to be replaced with electric incandescent lamps. He also suggests the city's owning its own lighting equipment and purchasing energy from the Public Ser. El. Co. The cost of changing the arc lamps is estimated at $3,480.

BALTIMORE, MD.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 14 for the installation of an electric freight elevator, hoistway, etc., in the United States post office, court house, etc., at Baltimore. For details see proposal columns.

UNION BRIDGE, MD. — The Union Bridge El. Mfg. Co. has applied to the Public Service Commission for permission to issue $5,500 in capital stock. The company is reported to have purchased the local electric plant and has been granted a 25-year franchise to furnish electrical service in Union Bridge.

FAIRMONT, W. VA.—Plans are being considered by the Fairmont Business Men's Association for the installation of a new street-lighting system in the business section of the city.

WASHINGTON, D. C.—The Public Utilities Commission is considering the recommendation of H. C. Eddy, engineer, requiring all electric-light wires placed underground in the District.

WASHINGTON, D. C.—The contract for installing new electrical fixtures in the Custom House at Washington has been awarded to Walker & Kepler, 531 Chestnut Street, Philadelphia, Pa.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 15, for a hydraulic lift at the United States Treasury Building, Washington, D. C. For details see proposal columns.

WASHINGTON, D. C.—Bids will be received at the Bureau of Standards, Department of Commerce, Washington, D. C., until June 25 for furnishing from time to time during the ensuing fiscal year annual supplies, including electrical work, etc.

WASHINGTON, D. C.—Foreign trade opportunities are announced by the Bureau of Foreign and Domestic Commerce in the Commerce Reports as follows: No. 17,180—A company in Honduras informs an American consular officer that it is interested in securing information and prices on X-ray apparatus and appliances, such as standard and portable machines, both static and coils, fluoroscopes, regulating tubes, compression diaphragms and electrotherapeutic apparatus. No. 17,203—An American consular officer in Persia transmits a report relative to an opportunity for the sale of copper sheets and solder. No. 17,206—Sealed tenders will be received by the secretary of Ragoon Municipality, Burman, India, until August 11, for the installation of a fire-alarm system. A copy of general specifications, etc., may be obtained from Ogilvy, Gillanders & Co., 67 Cornhill, London, E. C., Eng. No. 17,233—A firm of commission agents in Denmark writes a firm in New York City that it desires to represent American manufacturers of small hardware, cutlery, clocks, electrical fittings, etc. No. 17,238—A wholesale druggist in one of the insular possessions informs an American consular officer that he desires to receive offers from American exporters of electric-light bulbs with metal filament and pharmaceutical products, etc. Correspondence is desired in Spanish, but may be in English or French. Further information may be obtained at the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or its branches.

North Central

CHEBOYGAN, MICH.—The Cheboygan El. Lt. & Pwr. Co. is considering the erection of a new power plant on the Black River, moving the present plant from the middle of the river to the shore. The cost of the work is estimated at about $75,000. F. B. Spencer is secretary and manager.

DETROIT, MICH.—The Michigan State Tel. Co. has appropriated $500,000 for improvements, which will include a new toll line out Michigan Avenue and the installation of additional trunk lines between the exchanges in the city.

DETROIT, MICH.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 22 for a conduit and wiring system in the United States Marine Hospital, Detroit, Mich. Plans may be obtained at the above office or from the custodian at Detroit.

GRAND RAPIDS, MICH.—Plans have been prepared by Wernette-Bradfield-Meade, architects, of Grand Rapids, for a power house for the Imperial Furniture Co. Bids for construction of power house will be received until July 12. The company is also preparing plans for extension of power station of the Hydro-Electric Pwr. Co. at Lowell.

GROSSE POINTE, MICH.—The Grosse Pointe Township has awarded a contract for lighting the Mack Road to the Peninsular El. Co., of Detroit, for a period of two years. The contract calls for the erection of 60-cp lamps at a distance of 300 ft. apart on 8 miles of the highway.

PETOSKEY, MICH.—Plans, it is reported, are being prepared for the installation of a new municipal electric-light plant.

WHITEHALL, MICH.—The Frugale Pwr. Co., of Whitehall, has secured water rights and a dam site on Carlton Creek for the construction of a power dam.

CANTON, OHIO.—Tentative plans for the proposed ornamental street-lighting system on Tuscarawas Avenue have been submitted to the City Council, which provide for more than 100 lamp standards.

CINCINNATI, OHIO.—Arrangements are being made by Joseph Berning for the construction of a large garage building (for an automobile concern), which will be equipped with a machine shop. Contracts are now being let.

CLEVELAND, OHIO—Bids will be received at the office of the commissioner of purchases and supplies, Room 511, City Hall, Cleveland, until June 24 for one ambulance for the City Hospital. Specifications may be obtained at the office of the commissioner of charities and correction, Room 209, City Hall.

CLEVELAND, OHIO.—The Cleveland Tel. Co. contemplates extensive improvements and extensions to its system involving an expenditure of about $1,000,000. Of this $248,000 will be expended within the next three months. A new exchange building, to cost from $250,000 to $300,000, will be erected and cables will be extended.

CLEVELAND, OHIO—Bids will be received at the office of the commissioner of purchases and supplies, Room 511, City Hall, Cleveland, until June 25 for paper-insulated, lead-covered cable for the municipal electric light department. Specifications may be obtained at the office of the commissioner of light and heat division, 1443 East Third Street.

CLEVELAND, OHIO—Bids will be received at the office of the commissioner of purchases and supplies, Room 511, City Hall, Cleveland, until June 23 for construction of a pavilion in Rockefeller Park. Separate bids will be received on plumbing, heating, ventilating and electrical equipment. Specifications may be obtained at the office of the city architect, Room 420, City Hall.

COLUMBUS, OHIO—Application has been made to the Public Utilities Commission for permission to organize a new company, to be known as the Northwestern Ohio Lt. Co., for the purpose of taking over the properties of the Van Wert Pub. Ser. Co., Van Wert; the Delphos El. Lt. & Pwr. Co., Delphos; the Urbana Lt. Co., Urbana, and the Deshler light and power plant. The new company asks for authority to issue $481,000 in capital stock and $318,000 in bonds. Lindsey Hooper, of Boston, Mass., is president.

CUYAHOGA FALLS, OHIO—Plans are being prepared by Ernest McGeorge, architect, News Building, Cleveland, for construction of a one-story brick and steel power house for the Falls Rubber Co.

DAYTON, OHIO—The Dayton Pwr. & Lt. Co. expects to install one 7500-kw bleeder-type steam turbine with surface condenser and auxiliaries, one 750-kw, 600-volt rotary converter, for railway service, with necessary transformers and switchboard; also to erect certain transmission lines extending from Dayton into surrounding territory within a radius of approximately 20 miles. Contracts have practically been placed for the necessary equipment and material. The company has secured a contract to supply electricity to operate the system of the Oakwood Ry. Co., of Dayton. O. H. Hutchings is associate general manager.

FREMONT, OHIO.—The Sandusky River Pwr. Co., of Fremont, has filed notice with the Secretary of State that the name of the company will be changed to the Ohio State Pwr. Co. Application has also been made for an increase in capital stock from $900,000 to $1,000,000. The company has applied to the Public Utilities Commission for permission to issue $700,000 in bonds and $100,000 in capital stock. Plans are being prepared by the company for construction of a new steam-driven plant. The plant has been operated by water-power.

HAMILTON, OHIO.—A movement is on foot to light part of the Hamilton-Middletown pike with electricity. The utilities companies of Hamilton and Middletown are seeking the contract for lighting the new country club near Flenner's Corner.

NAPOLEON, OHIO—Bids will be received by Harry C. Rich, village clerk, Napoleon, until June 21 for furnishing material and installing single-unit lamp standards, constructing conduits and cables for same. For details see proposal columns.

NORWALK, OHIO—The contract for installing the municipal electric-lighting system in Norwalk has been awarded to the State El. Co., of Canton, at $45,000. The work includes a distributing system (overhead and underground) and ornamental metal lamp standards in the business section of the city.

STRASBURG, OHIO—The Town Council has granted the Ohio Ser. Co., which recently purchased the property of the Strasburg El. Co., a 22½-year franchise to operate an electric-light plant in Strasburg. The company will install new arc lamps.

WELLSVILLE, OHIO—The City Council has voted to advertise for bids for the sale of $60,000 in bonds, the proceeds to be used for the construction of a municipal electric-light plant.

CARLISLE, KY.—The Carlisle El. Lt. & Pwr. Co. is contemplating the installation of an ice plant, to cost about $15,000.

LANCASTER, KY.—A committee has been appointed by Mayor L. G. Davidson to make investigations as to the advisability of establishing a municipal electric-lighting plant.

LOUISVILLE, KY.—Specifications for the electrical installation for the addition to the Tyler Hotel have been completed by D. X. Murphy & Brother, architects. The plans provide for an additional three stories on the present eight-story building and an eleven-story addition.

SHARPSBURG, KY.—Local business men have organized a company for the purpose of installing an electric-light plant in Sharpsburg. Machinery for the proposed plant, it is understood, has been ordered.

BATESVILLE, IND.—The Batesville El. Lt. & Pwr. Co. expects to erect within the next three months 1 mile of transmission line to substation for water-works. A. W. Romweber is secretary and treasurer.

EVANSVILLE, IND.—Two passenger elevators and one freight elevator will be required in the new six-story building for occupancy by the Old State National Bank, which will cost about $250,000. The general contract has been awarded to the Scarborough-Davis Co.

IDAVILLE, IND.—Surveys are being made of Burnett's Creek with a view of utilizing the water-power to generate electricity. Frank Girard is interested in the project.

INDIANAPOLIS, IND.—The State Board of Buildings and Property has awarded the Indianapolis Lt. & Ht. Co. a contract for furnishing electricity for lamps and motors, etc., for the State House, for a period of five years. The contract was formerly held by the Merchants' Lt. & Ht. Co., of Indianapolis.

CHICAGO, ILL.—Within the next three months the Lincoln Park Commissioners expect to purchase 46,000 ft. 7000-volt lead-covered, triple-braided No. 6 series lighting cable, and 100 caps and grills for cement posts. Claude H. Shepherd is electrical engineer.

ELGIN, ILL.—The City Commissioners are negotiating with the Aurora, Elgin & Chicago R. R. Co., of Elgin, relative to the installation of a new street-lighting system.

FISHER, ILL.—The town of Fisher expects to purchase within the next 12 months a few meters and a small amount of weatherproof wire for the municipal electric-light plant. A. L. Baker is engineer in charge.

MARINE, ILL.—The plant of the Marine El. Ser. Co., which furnishes electrical service in Marine and St. Jacobs, was recently destroyed by fire. The company is erecting a temporary plant.

MOUNT VERNON, ILL.—The Citizens' Gas, El. Lt. & Htg. Co., of Mount Vernon, expects to purchase within the next six months two 5-kw and two 10-kw, 2200/1100/220/110-volt, 60-cycle transformers, 100 No. 6 irons (110 volts, alternating current), 12 vacuum cleaners and some miscellaneous appliances. H. A. Louwein is secretary.

OAK PARK, ILL.—Plans are being considered for the installation of a new street-lighting system in Oak Park.

WAUKEGAN, ILL.—Within the next six months the Public Ser. Co. of Northern Illinois, of Waukegan, expects to purchase poles, cables, transformers, meters, etc., to cost approximately $10,000; also electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, etc., costing about $2,000. Theadore A. Blech is local superintendent.

BELOIT, WIS.—Plans and specifications have been adopted by the street-lighting committee of the Council for the new ornamental lighting system. The plans provide for the erection of 94 single-lamp standards.

MILWAUKEE, WIS.—Negotiations are under way between the Plankinton El. Lt. & Pwr. Co., which furnishes electrical service to a large number of the large downtown buildings, and the Milwaukee El. Ry. & Lt. Co., whereby the latter will purchase the plant and holdings of the former.

WESTBY, WIS.—Preparations are being made by the village of Westby for the installation of a municipal electric-lighting plant, contracts for which have been awarded. The equipment will consist of two return tubular boilers (100 hp each), with automatic under-feed stokers and equipment for unloading coal from cars, two four-valve engines (100 hp each), two 75-kw, three-phase, 60-cycle, 2300-volt engine type generators, switchboard equipment, one 3-kw, seven 5-kw, three 7½-kw and ten 10-kw, 2300/1150/220/110-volt transformers; 25 new poles and about 5 miles of new weatherproof No. 6 wire, 200 meters and 50 series tungsten lamps. E. E. Dillon, of Madison, is consulting engineer.

LAKEFIELD, MINN.—The Council is considering calling an election to submit the proposal to issue $31,000 in bonds for improvements and extensions to the municipal electric-light plant and water-works system.

ST. PAUL, MINN.—The East Third Street Improvement Association is contemplating the installation of an ornamental lighting system on that thoroughfare.

DES MOINES, IA.—The Des Moines El. Co. is contemplating erecting a 44,000-volt transmission line to Knoxville to supply electricity to the local company there. The Des Moines company will also supply energy in Monroe, Otley, Prairie City and Colfax. The company will also install a 1500-kw rotary converter in its power house in Des Moines. Contracts have been placed for machinery and equipment. The transmission line will probably be extended to Oskaloosa next year.

EMMETSBURG, IA.—A committee has been appointed to purchase and install 111 electroliers.

FORT DODGE, IA.—Petitions are being circulated asking the City Council to call a special election to submit the proposal to issue $100,000 in bonds for improvements to water-works system, construction of dam and the installation of electrical generating equipment to supply the city with electricity for lamps and motors.

FULTON, MO.—Plans are being considered, it is reported, by H. W. Wright and Thomas Peterson, of Peoria, Ill., for the installation of an electric-light and power plant. Energy for operating the system will be obtained from the transmission lines of the Keokuk Pwr. Co., of Keokuk, Ia.

PLATTE CITY, MO.—Within the next two months the Platte City El. Lt. & Pwr. Co. expects to purchase one 56-ft., two-ply, 12-in. leather belt. Smith Clemings is owner and manager.

RICHMOND, MO.—Within the next two months the Missouri Gas & El. Ser. Co., of Richmond, expects to purchase one 18-ft. by 72-in. horizontal tubular boiler. Otto McMahon is local manager.

SPRINGFIELD, MO. — Ornamental lamps, it is reported, will be installed on Washington and Monroe Streets and Capitol Avenue this summer.

HARTFORD, S. D.—The Board of County Commissioners has granted the Hartford Lt. & Pwr. Co. a franchise to erect and maintain an electric transmission line from Hartford to Humboldt.

MILBANK, S. D.—Bids will be received at the office of E. M. Harper, county auditor, Milbank, until July 2 for construction of county court house to be erected in Milbank, in accordance with plans and specifications prepared by C. E. Bell, architect, Security Building, Minneapolis, Minn. Separate bids for heating, plumbing and electrical work will be received at the same time.

FREMONT, NEB.—Plans are being considered to extend the electrolier-lighting system in Fremont.

HOLDREGE, NEB.—The City Council has extended the franchise of the Holdrege Ltg. Co. for a period of 25 years. Under the terms of this extension the company agrees to make many improvements to its system and also a reduction in its lighting rates.

LINCOLN, NEB.—Bids will be received at the office of Theodore H. Berg, city clerk, Lincoln, until June 22 for furnishing and installing one 500-hp water-tube boiler with chain-grate stoker at the municipal water and light plant, in accordance with plans and specifications on file in the office of the city clerk.

LINCOLN, NEB.—Plans are being prepared by the Martz Engineering Co., First National Bank Building, Lincoln, it is reported, for an electric-light and power plant with an output of 450 kw, and the erection of 2½ miles of transmission line from the penitentiary to the State Hospital for the Insane, to cost about $40,000.

BURLINGAME, KAN. — Preliminary

plans are being prepared for extensions and improvements to the municipal electric-light plant.

OAKLEY, KAN.—At an election held recently bonds to the amount of $10,000 were voted for improvements and extensions to the municipal electric light plant and waterworks system.

TOPEKA, KAN.—The Executive Council has instructed Charles Chandler, state architect, to prepare plans for the special illuminating system for the State Capitol grounds, for which the last Legislature appropriated $9,750. As soon as plans are completed the Council will advertise for bids.

Southern States

SPRING HOPE, N. C.—Work is now under way on a hydroelectric power development on Tar River, 3 miles from Spring Hope; transmission lines are being erected to Spring Hope and Nashville by the Eastern Carolina Lt. & Pwr. Co. A franchise has recently been secured by the company in Zebulon, 13 miles distant. The company may also extend its lines to several other towns, covering a distance of about 30 miles. The cost of the plant is estimated at $20,000.

WILMINGTON, N. C.—A petition has been filed with the City Council asking for a new street-lighting system in the downtown section of the city.

ANDERSON, S. C.—The managers of the Equinox Mills are reported to be considering plans for the installation of an electric-lighting system for mill village.

FLORENCE, S. C.—At an election to be held June 30 the proposal to issue $140,000 bonds for the construction of a municipal electric-light plant and other improvements will be submitted to the voters.

ORANGEBURG, S. C.—The proposal to issue $15,000 in bonds for improvements to the municipal electric-light plant will be submitted to the voters on June 29.

CORDELLE, GA.—The City Council has decided to engage an engineer to prepare plans and estimates for the construction and maintenance of a municipal electric-light plant in Cordelle.

LEESBURG, GA.—The installation of a municipal electric-light plant in Leesburg is reported to be under consideration.

CHATTANOOGA, TENN.—The Tennessee Pwr. Co., of Chattanooga, has filed a $50,000,000 mortgage with the county registrar on its property in Blount County, to provide for a bond issue of the same amount. The proceeds are to be used for erection of transmission lines, building dams, etc. This, it is understood, means the financing of the building of the dams on the Little Tennessee River, which preliminary work has been in progress for some time.

HENDERSON, TENN.—Bonds to the amount of $57,000 have been voted for the installation of an electric-light plant, water-works and sewer systems.

MEMPHIS, TENN.—Decision as to whether the city will build a new municipal electric light and power plant or purchase the plant of the Merchants' Pwr. Co. is to be reached before July 1, by which time, under the charter of the company, the option must be exercised. The city has voted $1,500,000 in bonds to take care of the project.

SPRINGFIELD, TENN.—Plans are being considered to enlarge the municipal electric-light and water plant and to install additional machinery, to cost approximately $15,000.

WATERTOWN, TENN.—A. F. Tremble, it is reported, is contemplating the installation of an electric-lighting system. Electricity for operating the plant will be obtained from the transmission lines of the Lebanon Lt. & Pwr. Co., of Lebanon.

MARIANNA, ARK.—The property and holdings of the Marianna El. Co. have been purchased by the Arkansas Lt. & Wtr. Co., of Little Rock. It is understood that improvements will be made to the water plant.

MORRILLTON, ARK.—The Morrillton Lt. & Pwr. Co. has recently installed two new boilers (marine type) and one 200-kw, three-phase, 60-cycle, 2300-volt Ridgway generator, directly connected to engine, and switchboard. M. B. Morgan is president.

ANTLERS, OKLA.—Bonds have been voted, it is reported, for the installation of an electric-light plant, sewer system and for extension to water-works system.

MARSHALL, OKLA. — Bonds to the amount of $5,000 have been voted for the installation of a municipal electric-lighting plant.

TYRONE, OKLA.—The Council has granted the Tyrone Lt., Ice & Pwr. Co. a franchise to construct and operate an electric light and power plant in Tyrone. Walter J. Harville is reported interested in the project.

BALLINGER, TEX.—The Texas Pwr. & Lt. Co., of Dallas, it is reported, is negotiating with the owners of the local electric-light plant, with a view of purchasing same and operating it in connection with its other plants.

DAWSON, TEX.—Preparations are being made by F. H. Meier, of Teague, to install an electric-light plant in Dawson. Contracts have been placed for equipment, which will consist of one Fairbanks Diesel engine (provision has been made for another), one 20-kva, three-phase, 2300-volt Fairbanks-Morse generator, Westinghouse switchboard, eight to ten General Electric transformers (2 kw, 3 kw and 5 kw); one car load of Michigan cedar poles, and about 5 miles of wire. About 125 Westinghouse meters will be used and 22 street lamps, 60 and 100 watts.

GORDON, TEX.—The Gordon-Mingus Lt. Co., recently organized with a capital stock of $6,000, is contemplating the installation of an electric-light plant.

SILSBEE, TEX.—The Silsbee Ice Mfg. Co. is planning to install an electric-light plant. Machinery, it is understood, has been purchased.

Pacific States

CENTRALIA, WASH.—The City Commission has entered into a contract for a period of five years with H. G. Fleischauer, formerly manager of the Washington-Oregon Corporation, for furnishing energy to operate the municipal electric system. The contract provides for a new plant to be completed by October. The proposed plant will be operated by steam.

ELLENSBURG, WASH.—The contract for construction and equipment for the municipal electric-light plant has been awarded to W. A. Kraner & Co., Chamber of Commerce Building, Portland, Ore., at $58,500.

OLYMPIA, WASH.—The City Council has granted W. W. Manier a franchise to install and operate an electric-lighting plant in Olympia.

PORT TOWNSEND, WASH.—The Discovery Bay Improvement Co., of Port Townsend, recently incorporated with a capital stock of $60,000, it is reported, contemplates the construction of an electric power plant at old Junction City town site for the purpose of supplying electricity in this section. John Siebendaum and Martin Samuelson, of Port Townsend, are interested in the project.

HOOD RIVER, ORE.—State Engineer Lewis has issued a permit to August Guighard for the appropriation of 400 second-ft. of water from the Hood River. Mr. Guighard is planning to install a plant at the junction of Farmers' Ditch and Hood River, to develop 2273 hp at a cost of about $300,000.

MEDFORD, ORE.—The Rogue River Pub. Serv. Co., of Gold Hill, has filed a petition with the City Council asking for a 10-year franchise to furnish electricity in Medford.

SALEM, ORE.—The Snake River Mining, Milling & Smelting Co. has applied to the state engineer for permission to appropriate water sufficient to develop 500 hp on the Imnaha River.

VALE, ORE.—The City Council has passed an ordinance granting the Dead Ox Flat Irrigation District permission to supply electricity in Vale. This company is planning a 5000-hp water-power development on the Payette River, using the power to pump water out of Snake River to the upper branches of Dead Ox. H. W. Clements is secretary.

CHICO, CAL.—The advisory board of the State Engineering Department has authorized bids to be asked for the construction of a power house at the Chico State Normal School. The new station will replace the temporary building now in use.

ESCONDIDO, CAL.—The Escondido Mutual Wtr. Co. has applied to the City Council for a franchise to erect an electric distributing system in Escondido to supply electricity for lamps and motors.

LINDSAY, CAL.—The Tulare County Pwr. Co., of Lindsay, it is reported, has sold $300,000 in bonds, the proceeds of which will be used to pay outstanding indebtedness and for extensive improvements to its system.

LOS ANGELES, CAL.—In a decision handed down by the State Supreme Court the $6,500,000 power-bond issue voted May 8, 1914, is held valid. It is stated that $1,482,000 of the bonds have been printed and that this sum will be used in completing the San Francisquito Canyon power plant and in providing for the transmission of the energy to some central point in the city and distribution of same. The remainder of the proceeds of the bond issue will be used in acquiring the property of the Edison system, now in process of condemnation.

SAN FRANCISCO, CAL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 7 for the completion of the second story, including mechanical equipment, of the United States Sub-Treasury at San Francisco. Drawings and specifications may be obtained from Milton J. Dyer, Cuyahoga Building, Cleveland, Ohio, and from J. W. Roberts, supervising superintendent of construction, 403 Post Office and Court House Building, San Francisco, or at the above office.

SAN FRANCISCO, CAL.—Improvements have been authorized by the Pacific Gas & El. Co. as follows: Alameda County district, for the installation of a Cummer drier for use in conjunction with a lampblack filter system at Station B, to cost $11,287; Drum district, for replacing Girard turbine with impulse-type wheel at Alta power house, at a cost of $5,000; Redwood district, for installation of three 50-kw transformers at substation of Pacific Coast Steel Co., South San Francisco, to cost $8,440; San Francisco district, for the installation of two 822-hp boilers and superheaters at Station A, at a cost of $41,400, and for installation of 93 gas lamp-posts, to cost $4,078.

VICTORVILLE, CAL.—Within the next three months the Southern Sierras Pwr. Co., of Victorville, expects to erect three 1000-kva, 55,000/33,000-volt, water-cooled, out-door type transformers; also to purchase within the next four months two ranges, one washing machine, two sewing-machine motors, etc. B. T. Ergenbright is local superintendent.

BELLEVUE, IDAHO — The Rockwell-White Pwr. Co., of Bellevue, expects to erect within the next 6 months 25 miles of high-tension transmission line; also to purchase transformers and general equipment for distributing system. I. E. Rockwell is president.

KELLOGG, IDAHO—The Guelph Mining Co., it is reported, contemplates the installation of power plant, compressor plant, pumps, hoist and other machinery in connection with its property at Kellogg.

HAYDEN, ARIZ.—The American Smelter & Refining Co., which has purchased the Christmas Mines, it is reported, will install a new power plant at Hayden, which will supply electricity at Christmas.

Canada

AILSA CRAIG, ONT.—The proposal to enter into a contract with the Ontario Hydro-Electric Power Commission for electrical service will be submitted to the ratepayers.

Miscellaneous

PANAMA—Bids will be received at the office of the general purchasing officer, Panama Canal, Washington, D. C., until August 16 for furnishing 12 electric towing locomotives for canal locks. Blanks and general information relating to this circular (No. 938) may be obtained at the above office. For details see proposal columns.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until June 25 for furnishing steel, iron wire cable, wire, cable clips, chain links, brass tubing, yellow metal, sheet lead, plate zinc, etc. Blanks and general information relating to this circular (No. 934) may be obtained at the above office or the offices of the assistant purchasing agents, 25 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until July 1 for corrugated roofing, electrolytic oxyhydrogen generating plant, electric cable, cable end bells, circuit-breakers, glass lamp shades, battery zincs, dry cells, etc. Blanks and general information relating to this circular (No. 935) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 8, 1915.

[Prepared by Mitchell & Allyn, 41 Park Row, New York.]

1,141,937. TELEPHONY; E. R. Corwin, Chicago, Ill. App. filed April 5, 1913. Electromagnetic switch, calling extensions.

1,141,944. RESINOUS COMPOSITION AND PROCESS OF MAKING THE SAME; E. S. Dawson, Jr., Schenectady, N. Y. App. filed April 9, 1914. Dielectric condensation product.

1,141,945. ELECTRICAL SIGNALING DEVICE; W. W. Dean, Chicago, Ill. App. filed May 25, 1912. Adjustable noise horn.

1,141,953. ELECTRIC TRAIN CONTROL; L. J. Filitti, Albany, N. Y. App. filed March 17, 1914. Block system with signals.

1,141,979. ELECTRIC ELEVATOR; A. Rozier, Wembley, England. App. filed June 14, 1912. Gate operator and starter.

1,141,980. ARC-WELDING SYSTEM; J. A. Seede, Niskayuna, N. Y. App. filed Jan. 31, 1914. Shunt-resistance regulation.

1,141,982. RELAY; C. A. Simpson, Chicago, Ill. App. filed June 2, 1910. Pairs in a telephone system.

1,142,009. RADIAL-POLE DYNAMO-ELECTRIC MACHINE; O. T. Blathy, Budapest, Hungary. App. filed Jan. 31, 1912. Cooling device for rotating fields.

1,142,027. SOLENOID; R. C. Da Costa, Trenton, N. J. App. filed April 3, 1912. Coils embedded in an insulating spool.

1,142,033. TROLLEY-WHEEL GUARD; J. A. Gallagher and E. T. Herboltzheimer, Columbus, Ohio. App. filed Feb. 19, 1915. Attachment for the harp.

1,142,034. CORE FOR ELECTROMAGNETS; P. F. Gerding, Chicago, Ill. App. filed April 9, 1912. A tube containing iron filings.

1,142,037. LOCAL-CIRCUIT-CONTROLLING APPARATUS FOR PRINTING-TELEGRAPH SYSTEMS; G. S. Hiltz, New York, N. Y. App. filed Sept. 8, 1914. Automatic opening and closing.

1,142,047. INDUCTOR-GENERATOR; J. L. Milton, Chicago, Ill. App. filed Feb. 12, 1907. Improvement on patent No. 959,954 for ignition purposes.

1,142,056. COMBINED GENERATOR AND TIMER-DISTRIBUTER MOUNTING; J. H. Richards, Newark, N. J. App. filed Dec. 22, 1914. Removable independently.

1,142,062. SIGNAL DEVICE; M. F. Sitts, Chicago, Ill. App. filed Jan. 20, 1914. Telephone-answering device.

1,142,080. TELEPHONE ATTACHMENT; J. H. Clemons, Ilion, N. Y. App. filed July 18, 1914. Party-line non-interference.

1,142,086. IGNITER-ACTUATING MECHANISM; J. E. Gilson, Port Washington, Wis. App. filed March 30, 1914. Mechanical details.

1,142,094. PROTECTIVE DUCT FOR FIRE-DETECTING CONDUCTORS; C. A. Harsch, New York, N. Y. App. filed April 11, 1914. Insulated conductors with fusible connection.

1,142,102. STORE-SERVICE CREDIT SYSTEM APPARATUS; C. F. Kettering, Dayton, Ohio. App. filed Dec. 14, 1904. Sales-slip printing.

1,142,134. AEROPLANE APPLIANCE; A. H. Barrows, Chicago, Ill. App. filed Aug. 26, 1912. Audible inclination alarm.

1,142,151. TYPEWRITER WITH ELECTROMAGNETIC THRUST; J. Duiven, Lugano, Switzerland. App. filed April 16, 1914. Make-and-break device for permitting repetition.

1,142,172. METHOD OF TREATING CONDUCTORS; R. Jacoby, Berlin, Germany. App. filed April 11, 1914. Electrochemical treatment of tungsten filaments to produce uniform cross-section.

1,142,173. TELEPHONE; G. A. Janicke, Louisville, Ky. App. filed Oct. 31, 1912. Combined transmitter and receiver.

1,142,212. TIMING AND IGNITION DEVICE; W. W. Walker, Hanford, Cal. App. filed Jan. 16, 1914. Adjustable sparking mechanism.

1,142,213. SPLICE FOR LEAD-ARMORED CABLES; H. T. Whaler, Miami, Fla. App. filed Nov. 15, 1913. Head-connection construction.

1,142,220. ELECTROLYTE FOR THE PRODUCTION OF ALKALI AND ALKALINE-EARTH METALS; C. E. Acker, New York, N. Y. App. filed Aug. 5, 1910. Fused metal compound containing carbon and nitrogen.

1,142,228. IMPULSE TRANSMITTER FOR AUTOMATIC TELEPHONE PLANTS; G. A. Betulander Södertörns Villastad, Sweden. App. filed Feb. 26, 1913. Adjustable impulse mechanism and return device.

1,142,237. BOLSTER HANGER; A. Christianson, Butler, Pa. App. filed April 10, 1914. For motor trucks.

1,142,248. ELECTRIC-ARC LAMP; F. W. Gore, Quincy, Mass. App. filed Jan. 7, 1905. Automatic regulation.

1,142,251. ARC LAMP; E. J. Guay, Swampscott, Mass. App. filed Oct. 25, 1912. Inclosed flaming-type ventilation.

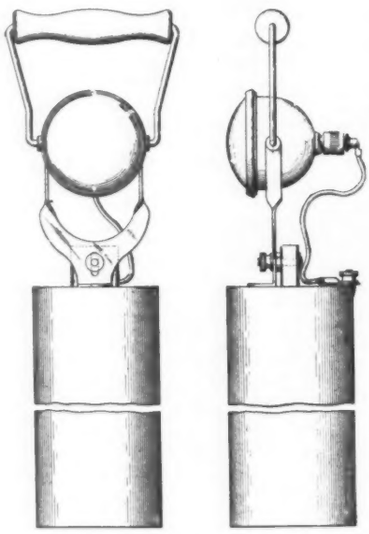
1,142,252. REMOTE-CONTROL HIGH-POTENTIAL SWITCH; W. E. Harkness, East Orange, N. J. App. filed April 28, 1913. Railroad-feeder circuit-breaker.

1,142,274. MEANS FOR COLLECTIVELY ACTUATING AND CONTROLLING ALTERNATING-CURRENT MOTORS; J. L. Routin, Paris, France. App. filed Jan. 7, 1914. Receiver shafts governed by a synchronous motor.

1,142,282. DEVICE FOR TEMPORARILY RETAINING CONDUCTORS; J. S. Stewart, New York, N. Y. App. filed Nov. 8, 1912. Molding clip.

1,142,306. ELECTRIC SOLDERING IRON; J. G. Clemens, Buffalo, N. Y. App. filed Nov. 21, 1914. Hand tool with automatic cut-out.

1,142,318. ELECTRIC SWITCH; D. T. Fisher, Columbus, Ohio. App. filed Nov. 10, 1909. Inclosed mine switch.



1,142,548—Electric Lamp

1,142,348. MINING MACHINE AND TRUCK; E. R. Merrill, Columbus, Ohio. App. filed Sept. 12, 1910. Power transmission and control.

1,142,378. CATENARY HANGER; W. C. Starkey, Mansfield, Ohio. App. filed April 6, 1912. Bendable strap.

1,142,382. MAGNET VALVE; G. P. Thurber, Pittsburgh, Pa. App. filed Aug. 23, 1907. For electric train control.

1,142,386. STERILIZED BRUSH; F. J. Wild, Jr., and A. J. Gettinger, St. Louis, Mo. App. filed Aug. 11, 1914. Rotatable metal bristles.

1,142,393. ELECTRIC HEATING PAD; H. E. Bloomer, Milwaukee, Wis. App. filed Sept. 8, 1914. Non-conducting body stitched with wire resistance.

1,142,394. LOCK HANGER FOR TROLLEY WIRES; G. H. Bolus, Mansfield, Ohio. App. filed July 22, 1911. Rotatable stud support.

1,142,416. BINDING POST; G. A. Gauther, Hartford, Conn. App. filed Oct. 28, 1914. Particularly for snap switches.

1,142,425. SYSTEM OF ELECTRIC METERING; E. Heilborn, Charlottenburg, Germany. App. filed July 25, 1912. Multiple-rate system.

1,142,428. METHOD OF MAKING A HOMOGENEOUS MECHANICAL JUNCTURE; A. B. Herrick, New York, N. Y. App. filed Nov. 29, 1912. Railroad-track welding.

1,142,462. ORE DISINTEGRATOR; L. St. D. Roylance, San Francisco, Cal. App. filed Dec. 27, 1912. Electrolytic tank with circulation and abrasion.

1,142,477. ANUNCIATOR DROP; C. Auth, New York, N. Y. App. filed Dec. 29, 1908. Magnetic holding device.

1,142,479. FASTENING CLIP; C. W. Beck, Detroit, Mich. App. filed July 21, 1913. Spark-plug stem connection.

1,142,482. PORTABLE ELECTRIC MOTOR; F. Bisch, Philadelphia, Pa. App. filed March 9, 1914. Wood-surfacing machine.

1,142,496. MAGNETIC LIFT FOR ELECTRODES IN ELECTRIC OSCILLATORS; A. H. Cohen, Fruitvale, Cal. App. filed April 29, 1913. Adjustable spacing of electrodes.

1,142,538. WIND-WHEEL LOAD REGULATOR; J. A. Snee, Jr., West Elizabeth, and T. H. Kerr, Pittsburgh, Pa. App. filed Oct. 29, 1913. Auxiliary regulating fan.

1,142,548. ELECTRIC LAMP; J. Berg, Chicago, Ill. App. filed Nov. 21, 1914. Dry-cell hand lamp.

1,142,552. PROTECTIVE DEVICE; E. R. Carichoff, Schenectady, N. Y. App. filed Jan. 15, 1914. Variable potential railroad regulation.

1,142,553. DAMPER-CONTROLLING MECHANISM; J. A. Colin, Merriam, Kan. App. filed March 17, 1913. For hot-air furnaces, etc.

1,142,572. SYSTEM OF ELECTRICALLY TRANSMITTING SIGNS; H. Hoffmann, Bremen, Germany. App. filed Oct. 21, 1914. Compensating coils for grounded circuit.

1,142,586. VARIABLE-RESISTANCE UNIT; S. W. Law, St. Paul, Minn. App. filed Feb. 26, 1914. For railroad-signal track battery, etc.

1,142,593. ELECTRIC MEASURING INSTRUMENT; L. Logan, Boston, Mass. App. filed March 5, 1913. Uses polarized-light principle.

1,142,597. SECTIONAL SUPPORT FOR PENDENT LIGHT FIXTURES; A. H. Manwaring, Philadelphia, Pa. App. filed Nov. 1, 1913. Chain construction.

1,142,600. SHIELD OR GUARD FOR TELEPHONES; R. H. Maxwell, Trenton, N. J. App. filed July 1, 1914. For mouthpieces and ear-pieces.

1,142,604. CLOCK ATTACHMENT; J. R. Moore, Winona, Tex. App. filed Jan. 11, 1915. For a series of alarm signals.

1,142,605. AUTOMATIC CAR SIGNAL; J. T. Moyer, Philadelphia, Pa. App. filed Feb. 7, 1914. For passing cars.

1,142,625. DISCHARGE TUBE; E. Reisz, Berlin-Treptow, Germany. App. filed Oct. 10, 1913. To effect uniform heating of the walls.

1,142,650. SIGNAL APPARATUS FOR MOTOR VEHICLES; J. A. Wilhelm, Detroit, Mich. App. filed May 22, 1914. Rear-signal arm and light.

1,142,678. TELEPHONE EXCHANGE SYSTEM; G. Dekin, Berkeley, Cal. App. filed March 8, 1912. Automatic repeater circuit.

1,142,684. TRANSMITTER FOR SYSTEMS OF ELECTRICALLY RECORDING SIGNS; P. Etienne, St. Imier, Switzerland. App. filed Aug. 19, 1911. Keyboard and controller.

1,142,695. FLUSH RECEPTACLE; G. W. Goodridge, Bridgeport, Conn. App. filed May 5, 1914. Cover-plate attachment.

1,142,709. COMBINED CABLE CLAMP AND BUSHING; C. Horn, Millbourne, Pa. App. filed April 3, 1914. For junction and outlet boxes, etc.

1,142,732. LOCKING DEVICE FOR CIRCUIT-CONTROLLING MEANS; R. Schoell, Stamford, Conn. App. filed Aug. 15, 1914. For automobile sparking circuit, etc.

1,142,751. STOPPING MECHANISM FOR TEXTILE APPARATUS; R. Crompton, Worcester, Mass. App. filed July 19, 1913. For looms (eighty-three claims).

1,142,759. TREATER FOR PETROLEUM EMULSIONS; R. E. Laird and J. H. Raney, Taft, Cal. App. filed July 22, 1914. For removing trapped water.

1,142,760. APPARATUS FOR TREATING EMULSIONS; R. E. Laird and J. H. Raney, Taft, Cal. App. filed July 22, 1914. For separating water from petroleum.

1,142,761. APPARATUS FOR DEHYDRATING PETROLEUM OIL; R. E. Laird and J. H. Raney, Taft, Cal. App. filed Oct. 26, 1914. Electrolytic.

1,142,769. ELECTRICALLY HEATED APPLIANCE; A. J. Block, Chicago. App. filed Aug. 22, 1912. Sadiron, etc.

1,142,771. ELECTRIC-HEATING SYSTEM; W. S. Hadaway, Jr., New York, N. Y. App. filed Sept. 7, 1911. Hollow tile and heating wires.

13,924 (reissue). METHOD OF PREPARING BARIUM OXIDE; L. E. Saunders, Niagara Falls, N. Y. App. filed April 28, 1915. (Original patent No. 112,721.) Heated under non-reducing conditions.